THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXI. No. 1572.] LONDON, JUNE 27, 1893. [45TH YEAR. PRICE 6d.

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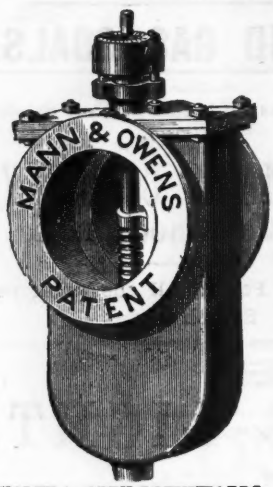

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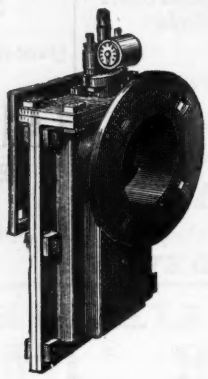

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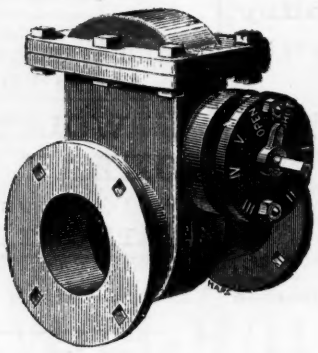

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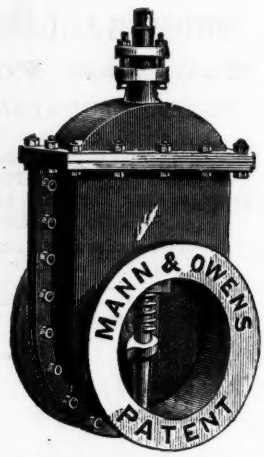

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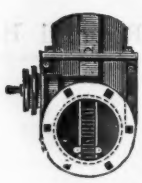

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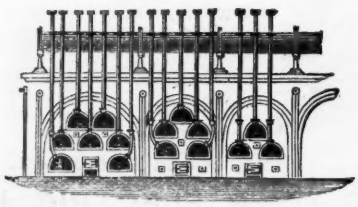

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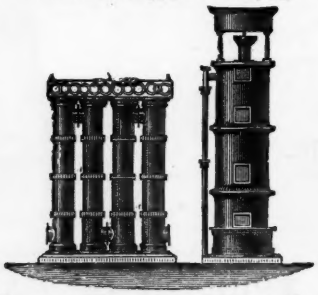

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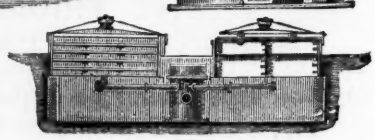

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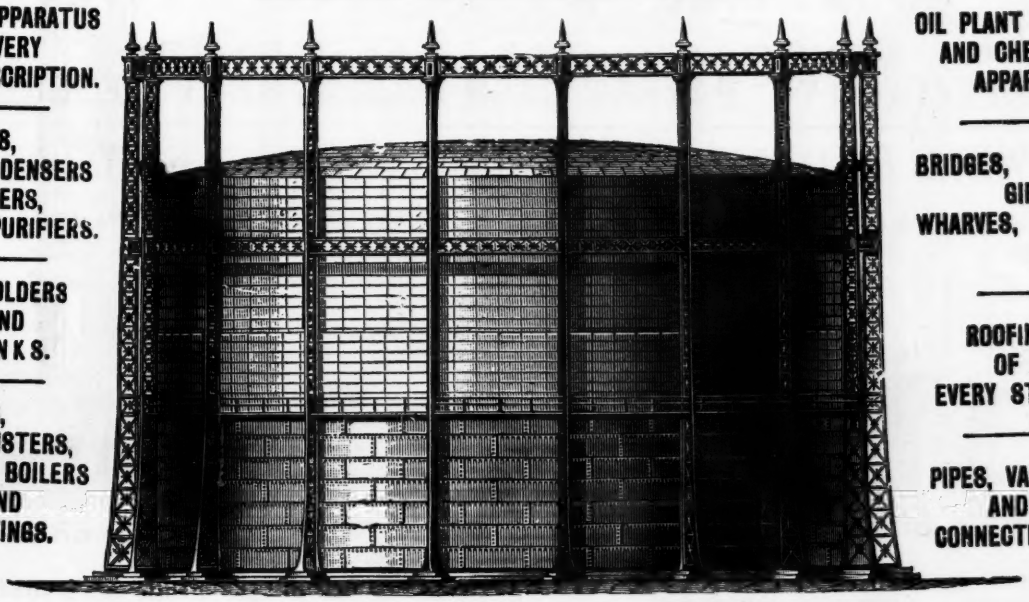

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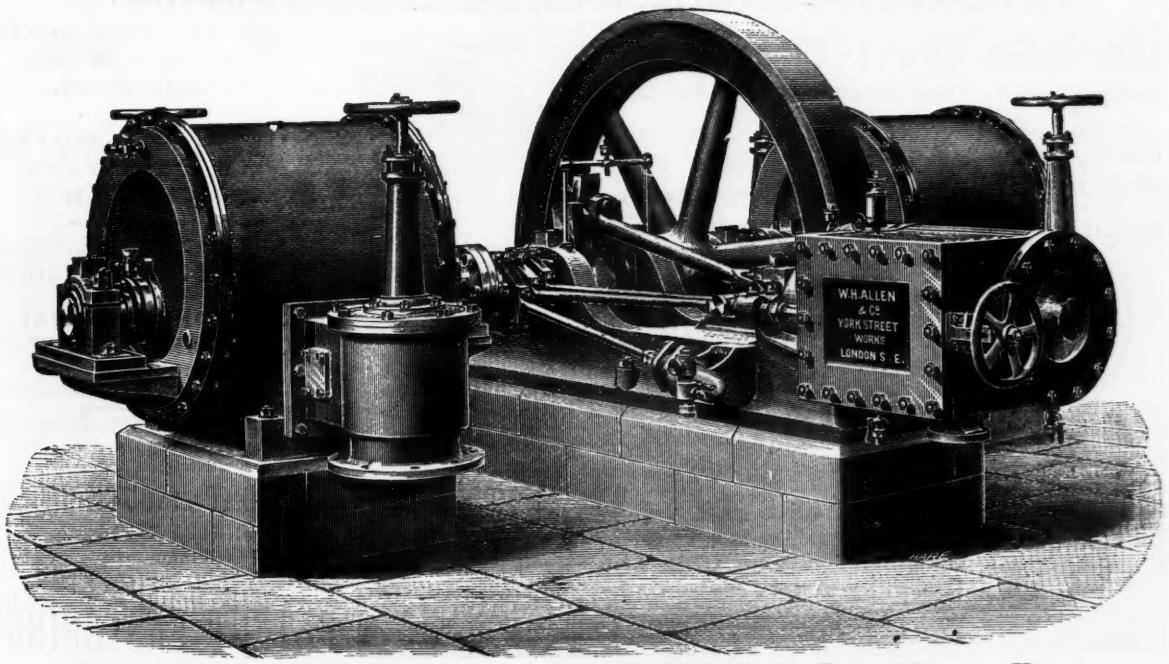

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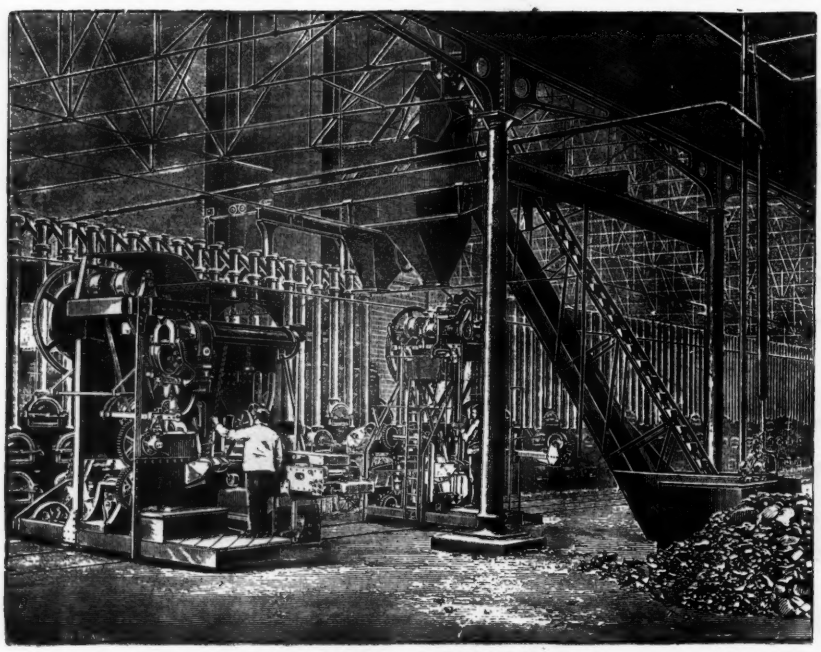

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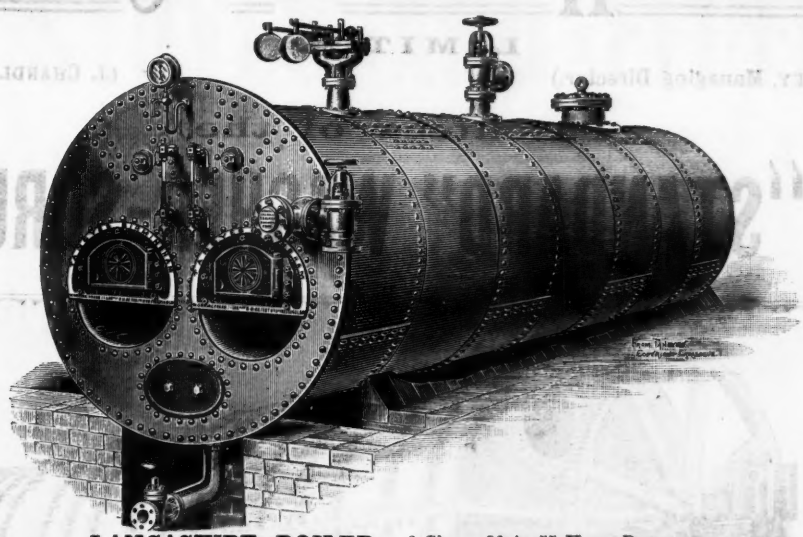

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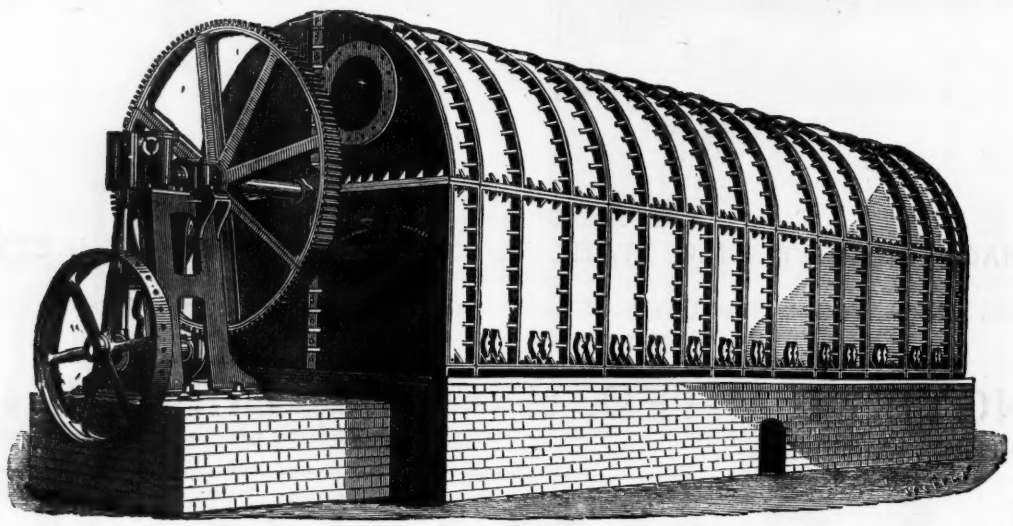

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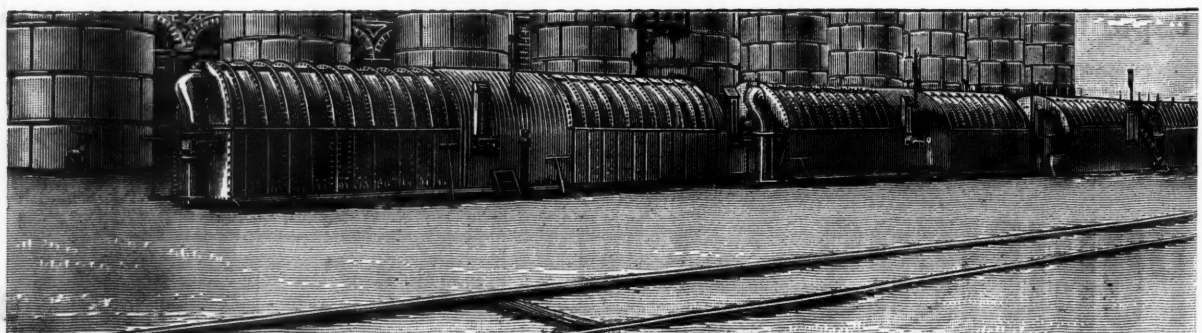

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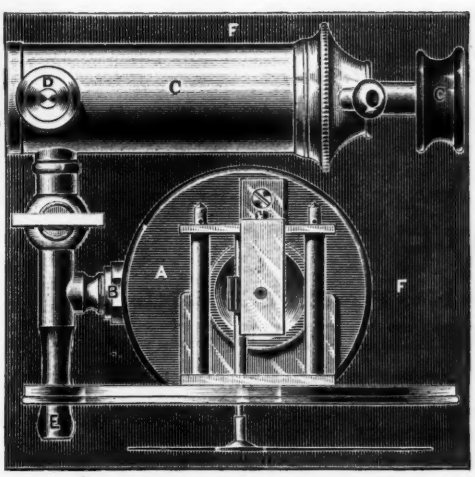

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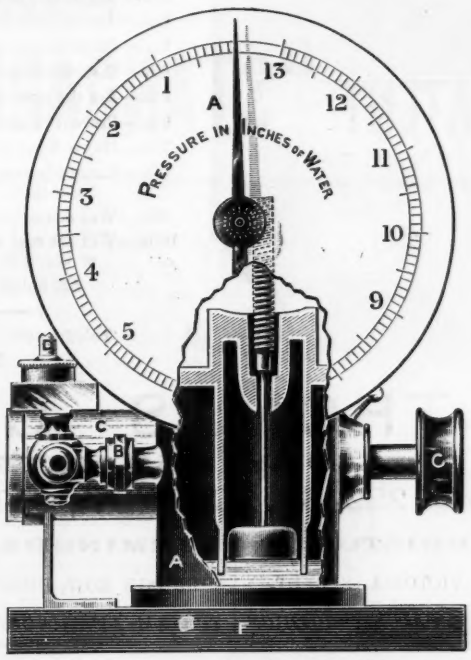

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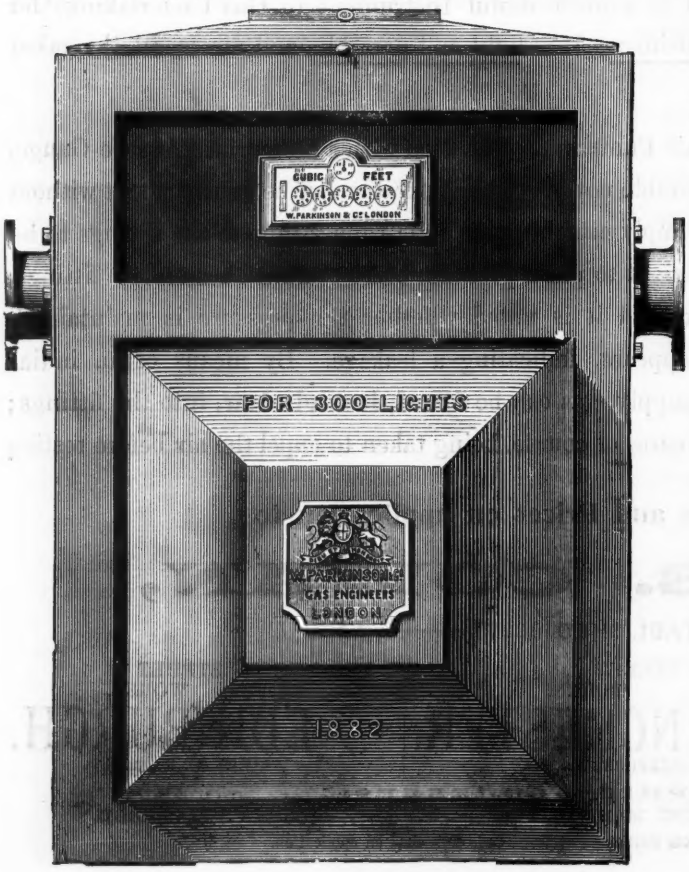

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 27, 1893.

M. Mallet's Address.

THE congress of the Société Technique de l'Industrie du Gaz en France took place in Paris on the 13th inst., as stated last week; and we are now in possession of the text of the Presidential Address delivered on the occasion by M. Mallet, who has received the unique distinction of being re-elected to the chair for the current year. In beginning his address, M. Mallet referred to the statement of his friend and predecessor in office—M. Melon—made before the Parisian Quinquennial Gas Commission in 1890, that for some time past the improvements made in gas-works are of an economical order, and he went on to enlarge on this text—showing how for many years gas managers have been preoccupied with the commercial side of their duties. The bulk of the address was accordingly devoted to the question of the actual condition and prospects of gas-works residuals, with a view to the possibilities of improving the market rates for this class of commodities. The future of tar and ammonia, said M. Mallet, is closely connected with the development of an industry allied to gas manufacture—namely, the production of metallurgical coke. Various types of coke-ovens, providing for the recovery of bye-products, are in use; and M. Mallet remarked that, while the tar recovered in this way is less in quantity than is usual in gas manufacture, the yield of ammonia may be larger, in consequence of the greater severity with which the process of washing can be carried out when the effect upon the illuminating power is negligible.

Neither in France nor in England, said M. Mallet, is the recovery of the bye-products from coke-ovens much practised; but there are upwards of 1250 such plants in operation in Germany. As to tar, M. Mallet observes that this product must always possess a minimum value, due to its utility as a fuel in comparison with the market price of other fuels; and this value would be higher if it could only be definitely established in favour for industrial processes requiring very high temperatures. The fuel briquette industry, which once promised an assured outlet for all the pitch that could be produced, is not developing, according to M. Mallet; and this not only because the output of slack, and poor slack at that, from the coal mines, is diminishing, but more especially because progress is being made in methods of burning the small coal directly in dust furnaces. The European railway companies, which were once the largest consumers of pitch and coal dust briquettes, are now gradually doing without them; the falling off in their demand being no less than about 25 per cent. during the past seven years. On the other hand, the popularity of the heavy tar oils for the preservtion of timber is growing in France. If the fashion of metallic sleepers should extend, however, the demand for creosote would again fall off. M. Mallet has no confidence in the future of coal-tar products, threatened by the competition of coke-oven products and those which may be derived from what he calls "the pyrogenation of the heavy por-"tions of Russian petroleums." He holds that it will be prudent to expect a depreciation rather than an increase in the value of coal-tar products, and consequently of the tar itself, during the next few years.

As to ammonia, after reciting the principal forms in which this product is consumed, M. Mallet remarks that the volatile alkali which once constituted the most considerable outlet for ammonia, has lost much of its importance. Ammonia refrigerating machines have created a new source of demand for the volatile form of the commodity; but their consumption is small. The same verdict is passed on the agencies for the consumption of chlorhydrate and nitrate of ammonia, as well as the concentrated liquor employed in the ammonia-soda industry. Sulphate is the most marketable form of ammonia; and M. Mallet devotes considerable attention to its comparison as a fertilizer with nitrate of soda. He mentions 1872 as the date of the commencement of the extensive use of sulphate by European agriculturists; and 1880 as that of the appearance of Chilian nitrate in the capacity of a very formidable rival. According to information for which M. Mallet confesses his obligation to M. Legrand, Belgium consumes, surface for surface, six times more nitrate than Germany, nine times more than France, and eleven times more than England; and not one of these countries as yet uses more than a small fraction of the quantity it could profitably employ on the soil. It is with a note of regretful resignation that M. Mallet admits that, while nitrate of soda remains cheap, sulphate of ammonia must continue the same, for the latter cannot conceivably possess any intrinsic value apart from the consideration of its utility as a fertilizer.

Coke is the principal bye-product of gas manufacture; and it is of the first importance that the market for it

should be kept active, and, if possible, improved. Thirty years ago, says M. Mallet, it would have been impossible to have disposed of the quantities of coke now produced. People did not know how to use it for domestic purposes; and there was no factory demand. From its earliest days, the Paris Gas Company have set about creating and cultivating the market for coke, and have fostered the trade in coke-stoves. M. Mallet also speaks approvingly of the Godillot, Perret, and Robin systems of burning breeze. The remainder of the address is devoted to a discussion of ways by which Gas Companies may hope to encourage the popular demand for coke; but M. Mallet's views are throughout pessimistic. On the whole, the address must be described as well worth attentive perusal.

We said something last week about the prize memoirs which the Société Technique receives annually; and we remarked that the device might be worth the attention of The Gas Institute. It appears, however, that the competition this year has been a failure. Only two anonymous essays came before the Committee—one being on the extraction of cyanogen from gas; and the other on the subject of the competition between gas, electricity, and petroleum. As to the former, the Committee thought it had better be brought before the Society as an ordinary paper, since the method of cyanogen extraction recommended by the author was not sufficiently supported by practical proofs to earn the distinction of a prize. With regard to the latter, it is dismissed as containing nothing new, and as being so seriously vitiated by mistakes as to be unworthy of reproduction even in the Transactions. This ruthless way of dealing with papers will astonish the weak nerves of some of our friends at home, who appear to think it treasonable for anybody to say that every paper submitted to a Gas Managers' Association is not a work of transcendent genius. The Society has awarded a gold medal to Dr. Auer von Welsbach, for his incandescent gas-burner, which they classify as constituting the greatest recent improvement in apparatus for the manufacture or utilization of gas.

European Gas Engineers and the Chicago Exhibition.

In our "Correspondence" columns to-day appears a hospitably-conceived greeting to all European gas engineers who may contemplate attending the Chicago Exhibition. Its spirit is excellent, and commands our respect. We also learn that the Executive of the American Gaslight Association, through the President (Mr. A. E. Boardman) and Secretary (Mr. A. B. Slater), have issued an official notice appointing and requesting certain of the members, eight in number, with Mr. W. H. White as Chairman, to serve as a Committee of Reception, to look up all gas engineering visitors to the States during the continuance of the Exhibition, with the object of giving them introductions to members of the profession, and in all ways making their stay in the land as pleasant as possible. The Guild of Gas Managers and the Society of Gas Lighting are requested to co-operate with this Committee, which these organizations will doubtless be delighted to do. Notification is further given to European gas engineers that the American Gaslight Association will hold its twenty-first annual convention in the City of Chicago, beginning on Wednesday, Oct. 18; and that it will give the members of the Association great pleasure to meet there as many of their European professional brethren as can make it convenient to be in attendance at the Exhibition at this time. If the date is not convenient, visitors are requested to send their names and addresses, on arrival in America, to the offices of the *American Gaslight Journal*, at No. 32, Pine Street, New York City, so that they may be waited upon on behalf of the Association, and be made to feel less like "strangers in a strange land." This is exceedingly kind and considerate of the administration and members of the American Gaslight Association; but it is only what might have been expected of the proverbial hospitality and easy cosmopolitanism of Americans generally, and of American gas engineers in particular. It does not need a Chicago Exhibition to evoke the friendliness of our "kin beyond sea;" and many British and Continental gas engineers have pleasant experience thereof, while more know full well that they have only to go to the States to find an overflowing welcome. All the same, we think it right to give prominence and currency to this formal invitation of the American Gaslight Association to their European colleagues; and we trust it will not escape the notice of those who may be in a position to take advantage of it. Our American contemporary asserts, in connection with this notification, that it has received advices from this side of the intention of many of its foreign subscribers to visit the States during this "summer "and fall, the main object of their visit to be, of course, "an inspection of the amazing Exhibition now under "way in the Metropolis of the West." It is to be hoped that our good friends on the other side of the water are not deceiving themselves by any such expectation; for the truth of the matter is that we have failed to discover among British gas engineers any interest whatever in the Chicago show. The Germans appear to be patronizing the Exhibition more than any other European country; and it is possible that a few German gas engineers may find their way across in the course of the autumn. But otherwise it is the simple fact that people on this side fail to perceive in the Exhibition any valid reason for going to Chicago now in preference to any other time. On the other hand, there are not a few who profess the existence of the big show to be a sufficient reason for staying away from America until it is over. There are very few practical engineers or men of business of any description in Europe who would not enjoy and profit by a trip to the States; but not to see an Exhibition, which no longer expresses an attractive idea. The thing has been overdone, like all other "sensations;" and it is time something else was discovered.

Railway Rates and Charges in Committee.

Mr. Shaw Lefevre's Committee on Railway Rates and Charges is slowly forging its way through the mass of matter with which it has to deal; and although it will be some time before the inquiry is terminated, no small amount of good is being done by the publication of the evidence taken in passing, which will facilitate the clearing away of several abuses. Striking evidence as to the bearing of railway rates upon the coal industry was given on this day week by Mr. W. S. Barrett, a Lancashire colliery proprietor, and a member of the Council of the Mining Association of Great Britain, who had been deputed to state the views of the Association. They complained that the Railway Companies had, in spite of assurances given by their managers in evidence on the revision, raised their rates, and made the rate for slack the same as for coal. What with the increased rates for coal and slack, and the carrying of 20 cwt. instead of, as formerly, 21 cwt. to the ton, Mr. Barrett estimated that the increased cost of coal carriage in the South Lancashire and Cheshire district alone would amount to £40,000 per annum. Another serious matter of complaint on the part of the coalowners is the power which, as they say, the Railway Companies claim and exercise under their new Acts of duplicating the short-distance charges, which presses very heavily upon colliery owners supplying gas-works near their pits. Mr. Barrett desired some "cheap and expeditious tribunal" which should have power to decide what rates are unreasonable, even when below the legalized maxima. A lurid light was thrown upon this question of special tribunals by the evidence of Mr. Macnamara, the Registrar of the Railway and Canal Commission Court, which was established for the purpose of deciding disputes between the Railway and Canal Companies and their customers. In theory, if a railway company fail of their duty to the public, anybody can go before the Commission and have the thing set right; but, as a matter of fact, the costs of proceedings before the Commission are so enormous, that the Court is only invoked in the heaviest cases. Yet the Court fees are perhaps the lowest known. Only £1 is charged on filing an application, 2s. 6d. for reply, and £1 as a hearing fee. Notwithstanding this apparent cheapness, when some Liverpool corn traders brought the Great Western Railway Company into the Court, the costs of the Company amounted to £1482; and the average expenses of the sittings are about £500 a day. Most of the outlay, said the Registrar, is in counsel's fees; and he could see no way of avoiding the employment of counsel. It is the same as we have always argued in regard to the cost of Bills in Parliament and cases in the Superior Courts. So long as litigants continue to run after fashionable counsel, and pay the extravagant fees demanded by these eminent gentlemen, justice by way of litigation must remain a luxury attainable only by the owners of long purses.

The "Labour Gazette"—a Miracle.

WHEN the first number of the *Labour Gazette* appeared, we devoted an article to the examination of this fresh product of Government enterprise. The second number has now been in circulation for some time; and it is rather surprising that so little notice has been taken in Parliament of the falling off of interest in its contents. It is becoming increasingly evident that the unfortunate policy of the Board of Trade, in confiding the duty of reporting on the state of employment in different parts of the United Kingdom to professional agitators, will, if continued in, ruin an otherwise promising journalistic experiment. An indication of the way in which the *Labour Gazette* is hampered by the character of the official correspondents is afforded by what it says about the Hull dockers' strike. In the tabular statement relating to "Trade Disputes of "the Month," which is swelled to a portentous length by the inclusion of every trumpery squabble lasting a day or so, there is a reference to the Hull strike, the "alleged "cause or object" of which is stated as "against the in-"troduction of the British Labour Exchange"—with how much truth, followers of the course of this struggle will be able to appreciate without any direction from us. The result of the strike is further declared to have been "work "resumed on a settlement mutually arranged, of which full "details are given in another column." Turning to this other column, we find set out in detail the "agreements" signed by Mr. Arthur Wilson, Mr. B. Tillett, and countersigned by the Mayor, by means of which the signal defeat of the agitators was attempted to be concealed. Why the unvarnished truth was not stated in the table is a question only to be answered by referring to the obligation under which the official editor lies to spare the feelings of the discredited demagogues. Dealing with the same subject, Mr. W. G. Millington, the local correspondent for Hull and district, prudently remarks that "it is as yet too soon "to judge of the effect produced on the general trade of "the port by the recent dispute." The official editor, dutifully following this lead, says "it is at present prema-"ture to attempt a general survey of the results of the "strike." We may be tolerably confident that, so long as the *Labour Gazette* continues in the present hands, no such "general survey" will be attempted. Mr. Millington is permitted to improve the occasion by advertising the Hull Trades and Labour Council, with which he has probably something to do, although his modesty suppresses the fact. He says that during the strike this body "collected £14,000, "which enabled them to pay strike pay at the rate of 6s. "per week for six weeks to about 9000 men." This is a very creditable piece of financing, for to pay this allowance to so many men for such a time as is here stated would require £16,200. Consequently, we are driven to the conclusion that, as these are official figures, the Hull Trades and Labour Council enjoy the power of working miracles. Generally, we are sorry to say, not all the money collected for strike relief pay goes into the proper channels; but in the case of Hull, the hands through which the cash passed actually served to increase its amount. The Chancellor of the Exchequer ought to look into this matter forthwith; for a few people blessed with this magic gift of making a sovereign go as far as twenty-three shillings would be very handy in the national spending departments.

An Example of the "New Journalism."

AFTER a long and chequered career, an old technical contemporary—*Iron*—which frequently did us the honour of conveying our matter into its columns, has ceased to have an independent existence; having become merged in the younger and more generally interesting publication entitled *Industries*. Henceforward, for a time at least, the fused periodicals will appear under the awkward double title of *Industries and Iron*. The more recent of these publications had the reputation of being conducted by writers who knew their subjects; but if we are to judge from the first number that appeared under the new *régime*, this is to be changed for the future, and British technical journalism will be the poorer by one more example of mere scissors-and-paste compilation, enriched by the lucubrations of pressmen who not only know nothing of the matters of which they presume to treat—one is used to this feature of the "New Journal-"ism"—but who cannot even write English. One precious article in the issue for the 16th inst., for example, is devoted to "Electric Lighting in London." In this we are told that "it is estimated that the plant capacity "of all the Metropolitan central electric lighting stations "reaches an aggregate of over 850,000 eight-candle power "lamps, assuming 35 watts to such a lamp." Then we may admire the style of a passage which runs thus: "The ratio "of lamps lit at any one time to lamps connected to the "mains does not over the whole of London ever rise "above 25 per cent." And as an example of absolute truthfulness we find this: "Experience proves that "the cost of gas and electricity to the consumer, as "judged from the price paid for the amount consumed, "does not appreciably differ." The stylist who perpetrated these sentences is, however, gracefulness itself in comparison with a colleague who, in dilating (on the same page) upon the performances of certain Atlantic steamships, tells how "the 'Paris,' *which* up to a few weeks "ago held the record, holds it no longer, having been "beaten by *her* more powerful rival, the 'Campania,' *who* "has lowered the time (!) by a few hours only." It may be said that this is cavilling over points of style which need not affect the sense. But our experience teaches that carefulness of style in journalism generally goes with carefulness in other things; so that poor diction only too often accompanies worthless matter. In the case in point, in the course of an account of the visit of the Federated Institution of Mining Engineers to Beckton, our very mixed contemporary states that, in the process of gas purification as carried on at these works, the gas passes "first through two vessels containing clean carbonate of "lime, which removes the whole of the carbonic acid left "in the gas; next through two vessels containing oxide of "iron, which cleanses it of sulphuretted hydrogen; thirdly, "through two vessels of lime that has been previously "sulphuretted, which removes the greater part of the "bisulphide of carbon; and, finally, through two more "vessels charged with clean lime, by which all traces of "sulphuretted hydrogen are eliminated." This sort of thing may be good enough for an evening newspaper conducted in accordance with the very newest and most progressive principles; but it will hardly serve to recommend a technical periodical.

A Large Coal Contract.—The Grassmoor Company, Limited, of Chesterfield, have secured the largest coal contract for the year at Leicester; the amount arranged for being 35,000 tons.

The Opposition to the Accrington Gas and Water Bill.—When the proceedings before the House of Commons Committee on the above-named Bill were adjourned on the 14th inst., as reported in our "Parliamentary Intelligence," it was generally thought that an arrangement had been come to between the parties But the negotiations have failed.

Presentations to Mr. Thomson.—Mr. R. B. H. Thomson, son of Mr. J. Thomson, Manager of the Inverness Corporation Gas-Works, was presented last Friday night, by Provost Ross, in the name of a number of the citizens of Inverness, with a gold watch, chain, and Cairngorm appendage, on the occasion of his taking up the duties of Manager of the Broughty Ferry Gas-Works. Mr. Thomson has also been presented by the members of Union Street United Presbyterian Church, Inverness, with a marble timepiece and three ornaments, in recognition of his services while a member of the congregation.

Death of Mr. James Paterson.—It is with particular regret that we have to record the death, on the 16th inst., of Mr. James Paterson, of Warrington, at the ripe age of 78. Mr. Paterson was beloved and respected by all who knew him, for the charm of his personal character, the unaffected kindliness of his manner, and his devotion to the scientific side of his profession. He was born at Stirling, in Peeblesshire, and removed early in life to Edinburgh, where he entered the service of the Edinburgh Gas Company. While quite a young man, he was appointed Manager of the Berwick-on-Tweed Old Gas Company, then in the throes of competition with a newer rival Company. After some years, the two undertakings were amalgamated; and Mr. Paterson was entrusted with the management of the joint concern. About thirty years ago, he received the appointment of Manager of the Warrington Gas-Works; and he remained at his post—first under the Company, and later under the Corporation—until 1888, when he retired with the title of Consulting Engineer. Mr. Paterson was devoted to the study of coal deposits, and published a well-known manual on the subject, entitled "The Lithology of Gas Coals;" while his multitudinous coal analyses, published in all text-books of gas manufacture, have been of the greatest assistance to the industry. Mr. Paterson was one of the original members of the British Association of Gas Managers, and was President of the Association in the year 1875. His name is happily preserved in the profession by two sons—Mr. R. O. Paterson, of Cheltenham, and Mr. T. O. Paterson, of Birkenhead.

WATER AND SANITARY AFFAIRS.

The Royal Commission on the Metropolitan Water Supply held two sittings last week. The first witness examined was Dr. G. Sims Woodhead, of Edinburgh, who gave evidence relative to the character of river water as affected by bacilli. The science of bacteriology was described as only yet in its infancy; leaving its students "still groping "in the dark." This being so, we have to rely "mainly "on experience." Dr. Ogle, who conducted most of the examination in the case of this witness, thereupon adverted to the experience of London, as showing that the water supply of the Metropolis was favourable to health, whatever might be the bacteriological indications. But the witness refused to accept this appeal to the facts, and signified that something wrong might happen in the future. He admitted that an experiment tried on millions of people for a series of years was so extensive as to carry great weight; "but," said Dr. Woodhead, "I would not "try that experiment upon myself." Having made this singular exception, he was asked whether he would not be prepared to drink any London water; to which he replied: "Not without first treating it myself as I should "wish to do." Dr. Woodhead, it appears, is so careful to guard himself against any possible risk, however remote and hypothetical, that he refuses to drink water taken from the Thames, or from any river draining a considerable area, unless it has been charged with carbolic acid for some time, or has been boiled, or else passed through a Chamberland filter at a comparatively slow rate. And yet his fear of meeting with the typhoid bacillus—the organism more especially under consideration—can hardly be understood, when we find him saying, in reply to Dr. Ogle, that the danger of typhoid bacilli coming down to London from Hampton was "very small indeed;" adding: "If everything were properly carried on, I think the "danger would be exceedingly small in the water from "the Thames Valley." There was also an admission of the fact that Dr. Koch approved of the London Water Supply as a standard for that of Hamburg. On the whole, the evidence given by Dr. Woodhead may be described as simply placing river water under suspicion, however good it may really prove to be. His statements were interesting, but practically inconclusive.

On a former occasion, we intimated some little surprise that the Royal Commission on the Metropolitan Water Supply should comprehend an inquiry into outbreaks of enteric fever in the Valley of the Tees. At the sitting on Tuesday last, the Chairman explained that, as these fever outbreaks had been mentioned by several witnesses —notably by some of those from the London County Council—the Commission thought it desirable to receive further evidence on the subject, so as to render the investigation as complete as possible. It was also felt by the Commission that, in some aspects, the fever outbreaks referred to had a distinct bearing on the subject submitted to them. While we admire the fair and open spirit which has led to the reception of this evidence, *pro* and *con.*, we still think the Commission might well have passed by the question of the Tees, as something outside their appointed sphere. The result has been to delay the completion of the inquiry; the Commission having to wait for the final report addressed to the Local Government Board by Dr. Barry, the Inspector charged with investigating the circumstances connected with the epidemic of enteric fever prevalent in the Tees Valley at certain dates. The character of the water supply being impugned, the Commission very considerately sent a copy of Dr. Barry's report to Mr. D. D. Wilson, the General Manager of the Stockton and Middlesbrough Water Board, inviting that gentleman to give such evidence as he thought proper in reply to the strictures of the Government Inspector. Mr. Wilson accordingly came before the Commission last week, armed with an immense mass of particulars, designed to show that the fever outbreaks in question were not due to the water supply, as stated by Dr. Barry, but to the imperfect condition of the sewerage in the district. The reply thus given is of a very elaborate character indeed, and leads the Royal Commission into what may be called a supplementary inquiry relative to the water supply of Stockton, Middlesbrough, Darlington, and various places in that vicinity. The defence of the local water supply is a strong one; and Mr. Wilson has been thanked by the Chairman for the pains he has taken. Next Friday, Dr. Barry is to be heard; and this, Lord Balfour of Burleigh states, will absolutely conclude the taking of evidence. The Commissioners are obviously anxious to issue their report.

The three-cornered duel—or, more correctly, combat—in Parliament between Plymouth, Devonport, and Stonehouse has ended without dire results. The House of Commons Committee have passed the preamble of the Stonehouse Bill, except so far as it related to the construction of additional works. The preamble of the Plymouth Bill has passed unaltered. So, too, has the Devonport Bill passed, after the elimination of the recital that it would be advantageous to the Stonehouse district that the Local Board should obtain an additional water supply from the Devonport Company. But, without going into controversies that have now been discreetly buried, it may be observed that the recent parliamentary inquiry has not been without some useful and instructive results. It has brought into notice the danger and confusion which may arise from loose draughtsmanship, by showing how much misconception and doubt have arisen through the adoption in a Bill of such a vague and elastic phrase as "adjacent "parts." It has demonstrated also the serious consequences of passing unopposed Bills without thorough investigation. In connection with the Plymouth Bill, Mr. T. Hawksley's evidence made it clear that the Head Weir site, which was actually sanctioned by Parliament in 1887, and had since been abandoned, was utterly unfit for the purpose for which it was required. Very naturally, Mr. Hawksley desired to remove the impression that he, as the Consulting Engineer, had approved of this site. He affirmed, on the contrary, that he had always entertained grave suspicions as to its soundness, and that these suspicions had been amply justified by the event. Explorations made after, instead of before, parliamentary powers were sought and obtained, established the fact that the site was in the middle of an ancient lake, which had been filled up with Dartmoor *débris*, and therefore was a totally unfit position for a reservoir dam. How came it, then, that this highly-dangerous site was selected, and, so to say, palmed off on Parliament? Mr. Hawksley's explanation is plain and simple. He says that he was directed by the then Water Committee to adopt that site, without waiting to make explorations. And he did so, evidently against his better judgment. Herein lies a grave lesson both for Water Committees, Engineers, and Parliament itself. A Water Committee, or other non-professional body, must always incur the most serious responsibility when they act upon their own judgment in such a matter as this. They have no right to coerce their adviser; and their adviser ought not to allow himself to be coerced. Nor should a Parliamentary Committee assume that a scheme is sound and practicable merely because it comes before them unopposed. The history of this Head Weir scheme came, as the Chairman (Sir Richard Temple) observed, in the light of "a revelation" of the way in which faulty and unworthy schemes are sometimes passed through Parliament. Mr. Pope, Q.C., whose experience, of course, is very great, endorsed the Chairman's remarks; and added that many unworthy Bills are slipped through, when unopposed, because Committees do not satisfy themselves as to their merits. It is to be hoped, therefore, that the significant lesson taught by the Plymouth case will henceforth be carefully borne in mind by all whom it concerns.

The Late Mr. H. Gill.—By way of testifying to the respect in which the late Mr. Henry Gill, the Chief Engineer and Manager of the Berlin Water-Works (whose death we announced last week), was held by the whole community, and especially by the British colony, of which he was one of the oldest and most esteemed members, the British Embassy and the Berlin Municipality were represented at his funeral, which took place last Wednesday.

The Wire-Rope System of Guiding Gasholders.—It will interest gas engineers to learn that the legal proceedings which have for a considerable time existed in connection with the use of the wire-rope system of gasholder guidance at Manchester and Haslingden have been terminated by an arrangement whereby the firm of Messrs. Ashmore, Benson, Pease, and Co., Limited, have obtained an assignment of the patent of Messrs. Gadd and Mason upon which these proceedings were taken. All the patent rights of this system of gasholder construction are now in the hands of the above-named firm, who will therefore be in a very strong position to push this speciality without fear of further legal difficulties.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTIETH ANNUAL GENERAL MEETING,

HELD AT

THE CITY HALL, BELFAST, JUNE 13TH, 14TH, & 15TH, 1893.

DENNY LANE, ESQ., M.A., President.

DISCUSSIONS ON THE PAPERS.

We commence to-day our report of the discussions on the papers read at the above meeting; beginning with the first two which appeared in the JOURNAL last week.

MESSRS. LYNE AND TRAVERS'S PAPERS ON GAS-FITTINGS AND GAS-BURNERS.

The PRESIDENT, in inviting observations on the above-named papers, said there was a tendency among some gas engineers to look at the larger elements of the industry, and to underrate the smaller ones; but these very small things were those which really constituted the great acting forces in Nature. The elephant did not produce half such effects as the little mite of the phylloxera, which did so much damage to the vines. That microscopic insect had done more harm in its way than troops of elephants could ever cause. In the same way, the sheep had suffered from the "fluke"—a disease which was generated by a microscopic animal that was contained in the body of a small snail. It often happened that what were called the minima were really the maxima. Gas managers might feel very proud when they regarded a large holder containing 12 or 13 million cubic feet of gas, and might think it very admirable; but if they looked more into the small details of the apertures of burners, and their suitability to the pressure and quality of gas, it would perhaps be found that these extremely minute matters might have more practical effect on the interests of the industry than the large things whereof they were so proud.

Mr. W. A. VALON (Ramsgate) agreed with the readers of both the papers that much more should be done by gas companies than was accomplished at present with regard to internal fittings. The consumer was not so much to blame as the gas authorities. Until 1882, when the first Electric and Gas Exhibition was held at the Crystal Palace, gas companies and corporations systematically neglected to educate the consumer in the proper use of the article they were selling. Excuses might be raised that up to that time gas engineers had had as much as they could do to perfect apparatus for the manufacture of the gas itself, and to provide for the enormous increase in consumption which went on from year to year. But what they had been compelled to do since might have been done somewhat earlier; and they would then probably have been saved from the unpopular position they held at the present time, which he believed was due principally to their comparative neglect of the consumers until quite recently. Things were now mending, however. Since 1882, gas exhibitions had been held in all parts of the country. The makers of gas-stoves were encouraged to produce articles and to compete with each other; and the engineers, according to their judgment, supported those who, in their opinion, supplied the needs of the public best. So with the makers of gas apparatus, fittings, and so on. But that was only a development of later years. They must not blame the consumers, or expect too much of them, because the gas-fitter, being as a rule an uneducated man, took advantage of the position the companies accorded to him to push whatever he might have in stock; and, after he had put the consumers to a large expense—doing little or no good—he could turn round and say it was not his fault, but that of the gas company. For some time past they had been trying to educate consumers; and they had succeeded to a large extent. Many companies instructed their inspectors to carry burners with them, so that a consumer might substitute one free of cost. It was not always necessary to have an expensive burner to get a very fair result. Again, companies were now striking out in a new direction, and supplying gas-fittings free of cost to the consumer to this extent—that the fittings themselves were paid for as a slight addition to the cost of the gas; and he believed, wherever this system had been tried, it had proved a great success. He did not know whether or not he might claim the credit of being the first to introduce it; but he believed he was. It was started at Ramsgate in June, 1890; and at the end of March, 1893, they had fitted up more than 600 houses, and there were 589 actually under supply. The amount expended on fittings was £1403; the average cost per house being £2 7s. 7¾d. By charging for the gas 7d. per 1000 cubic feet more than to the ordinary consumers, and setting it aside to clear off the cost, £517 17s. 5d. had been paid off in three years; so that the 7d. per 1000 feet would be enough to pay the expense of fittings in each case in about five years. The extra rental received in the first year was £436; in the third year, £1252; and it was still increasing. He mentioned these figures to show that there was no risk whatever in adopting this system. They had for the small consumers a prepayment meter—not a penny-in-the-slot-meter, but one by which the index was moved on a certain distance—asking the consumers to pay 9d. for 200 cubic feet, or 1s. 6d. for 400 cubic feet, which they had no difficulty in getting them to do. This was the total amount they were called upon to pay before getting a complete supply. He need not say that this entailed the necessity of looking after the consumers. In doing so, it educated the inspectors to give special attention to those who were not on the system, but who from time to time complained; and the result had been very satisfactory. The consumers had more frequent visits from the inspectors; and this was very desirable. If gas companies would realize their responsibility, and endeavour to educate the consumers to come to them, and not go to anyone else, so that they might have the best advice, and in fitting up new houses would take care that the inspector was always there to see that the gas-fitter did his work well, they would be on better terms with their customers, and have more satisfactory results. If the two papers under discussion had the effect of urging companies and corporations to look after consumers better, they would do great good.

Mr. H. TOBEY (Malton) agreed with the authors of the papers that bad burners were one of the greatest evils that existed. At the same time he thought Mr. Travers's suggestion for making a gratuitous distribution of burners was taking up the matter in the wrong way. If one offered a man something for nothing, he looked with suspicion, especially if one had a bad character already; and gas companies, he was sorry to say, did not bear the best reputation among the public. Consumers knew there were certain Acts of Parliament to protect their interests. There was an inspector of meters who had to check the measures of the gas company; and the inference was that the companies were disposed to supply unjust measures. In addition to this, there were persons appointed to test the quality of the article supplied, and occasionally they saw that gas companies were brought before a Court charged with supplying gas of inferior quality or impure, and fined; and thus the consumer conceived the idea that the companies were not exactly his friends, and were rather inclined to take advantage of him when they had the opportunity. Therefore, when they offered to put on a lot of burners for nothing, it engendered a certain amount of suspicion. The gas-burner man, on the other hand, did not offer to supply his article gratis. He told the consumer what it would do in the way of purifying the gas and adding to its illuminating power; and when he was asked the price, of course he said he could not supply such a burner as the one he had for less than 6d. or 1s., or whatever the price might be. He thought the practice of giving burners away out of pure kindness would not be attended with the best results; but, if companies charged a fair sum, their efforts would be better appreciated. It was proposed in one of the papers to add to the meter testers and illuminating power testers a gas-burner tester, who would see that these things were made of better quality. He did not agree with the insinuation which seemed to be made against gas-burner makers that they were not up to the times; for people could now get remarkably good burners for a mere nominal sum. He thought there was no necessity to add to the officials who already burdened society.

Mr. G. HELPS (Bath) said he could not agree with the remarks of the last speaker. Although the papers perhaps referred to a small matter as compared with engineering work, they were of great importance to gas companies. He had been connected with a gas undertaking for a good

many years, and had seen the necessity for co-operation between the engineering and secretarial departments, or, in other words, between the manufacture of gas and the attention necessary to be given to the consumer. The engineer had many important and difficult duties, and so had the secretary; and he had come to the conclusion, after forty years' experience, that the greater attention that could be given to the consumer, the better it was for the directors and shareholders. He always told his clerks to be very attentive to the consumers, and give them all the information they possibly could. But it was at times exceedingly difficult to satisfy them; and some would not be satisfied whatever might be done. He recollected an instance of a friend of his coming down to the office, and asking for him personally. He said he wished someone could be sent up to attend to his dining-room chandelier, for he could not see to eat his dinner. He (Mr. Helps) sent a man with some new burners; and his friend afterwards informed him he could see to eat with one burner, whereas before he could not see with three. He knew many instances of a similar kind. For several years they had put in gas-fittings when desired, but did not try to interfere with the fitters of the town. It was a well-known fact that tenders were obtained for fitting-up houses, and the lowest tender was accepted; the result being that there were constant complaints of want of gas. He lived for ten years in a house which was well fitted up, where he had a wet meter, and a good supply of gas; but other people in the neighbourhood used to complain of a bad supply. Of course, the fault was with the burners or fittings. Mr. Lyne had spoken in favour of dry meters. In his house, as before mentioned, he had a wet meter, which, as he had said, was perfectly satisfactory; but when he went to another house where there was also a wet meter, he was obliged to have it taken away, and a dry one put in, simply because of the bad fittings. As a London gas-fitter once said to him, a wet meter is the best, so long as it is well made; and a dry meter is a great help to a bad gas-fitter. They had now nearly all dry meters; but they were continually coming in for repair, although they were from the best makers. In his experience, they were generally slow—from 5 to 50 per cent. He thoroughly agreed with gas companies attending to their customers—paying them every attention they possibly could, even to giving them gas-burners to please them, which would do good to the company all round.

Dr. Stevenson Macadam (Edinburgh) said that the first occasion on which he had an opportunity of reading a paper on this subject was at a meeting of the North British Association of Gas Managers, at Perth, in 1872. He then made allusion to the loss of gas which consumers sustained by the employment of bad burners, which were not suitable for the consumption of gas. One subject he then dealt with was the amount of light obtainable from different-sized burners, even when made by the same maker; and he found a rather startling result. He commenced with 28-candle gas, which was then supplied to Edinburgh; and that amount of light was given when the gas was consumed properly at 5 cubic feet per hour. But if it were consumed at 4 feet per hour, but calculating it at 5 feet afterwards, they only obtained 93 per cent. of the actual light—7 per cent. being lost on being passed from the No. 5 to the No. 4 burner. When passed through a No. 3 burner, only 82 per cent. of the actual light was obtained; with a No. 2, they lost 30 per cent. of the light; and when he tried a No. 1 burner (which was often used in small towns), he only got 54 per cent., and when he tried a 0·5 burner he only realized 36 per cent., or one-third, of the total light, and lost 64 per cent. That was one branch of the subject of which the public were at that time very ignorant; and he thought it right that the gas managers and officials who came into contact with the public should be able to instruct them that, in the use of certain burners, they were losing a great amount of light. He agreed with Mr. Helps and other speakers that it was not only the province but the duty of corporations and gas managers to instruct the public how to use the materials which they placed in the hands of their customers. Another department of the subject was the difference in light obtained under different pressures from the same burner. Without going into the actual figures—which could be referred to, and which were published in 1872—he might say this: They all knew that, when the gas-fittings were too small, in order to get a certain amount of gas through them, it must be pushed through under greater pressure; whereas, if they were large, the gas could be consumed at a diminished pressure. His experiments brought out the fact that actually by excessive pressure, as compared with ordinary pressure, light was lost—in some experiments as much as two-thirds. In these wasteful trials, but still common in themselves, they were burning gas to some extent in the Bunsen style—throwing too much of the air and gas together for proper photogenic consumption—and they did not get the true illuminating power of the light developed. Subsequently in an important investigation which took place in connection with the passing through Parliament of a Corporation Gas Bill for Glasgow, the late Dr. Wallace was associated with him in an inquiry how far the Corporation would be justified in reducing the quality of their gas from 25 to 21 candle power. Before the Parliamentary Committee, they brought forward the results of investigations made with different qualities of gas with different sizes of burners; and they gave evidence to the effect that, looking at the ordinary but wasteful way in which the Glasgow people had been burning the good gas they were getting (which was equal to 25 candles), they would not, so far as the light-giving power was concerned, be put at a disadvantage if the power were brought down to 21 candles, provided that the Gas Committee's officials would instruct the consumers as to the proper burner with which to burn the 21-candle gas. He was sorry to say the evidence then given before the Committee of the House of Commons was afterwards misunderstood in some quarters. They, however, held that 25-candle gas consumed in bad burners was no better than 21-candle gas consumed in good burners; and that the Corporation were quite entitled to go into the question of selling 21-candle gas, provided they could satisfy the Parliamentary Committee that, with properly-constructed burners, they could get as good a light with 21-candle gas as with the ordinary run of badly-constructed burners and 25-candle gas. The Bill passed, enabling the Corporation of Glasgow to give a reduced quality of gas; and since that time, he was glad to say the practice which Mr. Helps had carried out at Bath had also been the practice in Glasgow. The officials there instructed their customers as far as possible in the employment of better kinds of burners—in many instances even supplying them free of cost. He might refer to one other set of experiments, which were made to show how far the gas, even when consumed in small quantities, could be compelled to give a light which was equal to that evolved when consumed in large quantities calculated at 5 feet per hour. Dr. Wallace and himself had carried out a set of experiments in this way: They took a No. 8 Bray burner, and removed the "stuffing" from it, and passed through it 5 cubic feet of gas. At that time the pressure was about 5-10ths. They got from it a certain lighting power, which was called the standard. It was 20-candle gas. When the pressure was reduced to 4-10ths, and burnt at the rate of 4·28 cubic feet, they got practically the same light when calculated for the same 5 cubic feet. Then they reduced the pressure to three-tenths by the same burner, consuming 3·7 cubic feet, and obtained practically the full quantity of light for the 5 cubic feet. Then they reduced it to two-tenths, consuming 2·85 cubic feet, and even to one-tenth, consuming 2·2 cubic feet, and at the very lowest they only lost 3 per cent. of the total light for the 5 cubic feet. It appeared to him from these observations that, if the pressure could be kept down as far as possible, it was in favour of the proper consumption of the gas so long as the carbon was consumed. Of course, it was not right to have a smoky flame. The larger the fitting admitting of the gas being consumed at the burners with a white flame, and without smoke at reasonably reduced pressures, so much the better for the amount of light which the consumer would get from the gas.

Mr. Helps said in one part of Mr. Lyne's paper he stated that, as the gas used for cooking and heating purposes bore only a small proportion to that consumed for lighting, so much the more was the latter worth all the care and attention that could be bestowed upon it. In Bath there was very little increase in the consumption of gas for lighting; and therefore they deemed it necessary to do all they could with gas-stoves. He thought the consumption of gas at Bath for other than lighting purposes was between 35 and 40 per cent. of the total.

Mr. Tobey said he had been somewhat misunderstood by

Mr. Helps and Dr. Macadam. He did not wish to deprecate in any way gas companies trying to improve the supply to the consumers. He himself did not allow a consumer to complain twice, if he could avoid it. The only thing he demurred to was supplying burners free.

Mr. John West (Manchester) said he was very glad this important matter had been brought forward. It was one of those subjects in which he took great interest; and he contended that it should be part of a gas engineer's education. Fortunately for himself, when he was articled, it was a portion of his apprenticeship that he should learn gas-fitting. He had seen many advantages in connection with the Company he was brought up with having full and complete control over the manufacture and supply of gas from the retort-house to the burner. When he first went to Northampton, about forty years ago, the Company did the whole of the fittings—in fact, it was looked upon as a monopoly. There was not a gas-fitter in the town; and everyone assumed that no one but the Gas Company had a legal right to put up gas-fittings, and consequently no one did it. He was pleased to say that they encouraged gas cooking very much. The first day he went there, he saw gas-stoves being made on the works. Mr. Valon, therefore, was not correct in saying that Gas Companies only began to do something in 1882. A large number had done something before that; but at the same time it was better to begin late than never. In doing this, the Northampton Gas Company came into contact with the consumer; and this was the most important point. They adopted all the best appliances; and at that time they had a larger show-room than Winfield's even had in London—fitted up with everything of the very best character. After a time, a jealousy cropped up; and it was said that the Company had no right to this monopoly. Accordingly they advertised that there should be no monopoly; and that they would sell fittings and burners to the trade. Certain enterprising plumbers then started to do gas-fitting; and some of the large people in the town went to the new firms. But after a time they came back again to the Company, in order to get their work done properly. One of the things the Company did was to supply their customers with the very best of burners; and he must say he saw a greater variety of burners collected together forty years ago than he had ever seen since. The late Mr. Sharp—who afterwards went to Southampton—had given an order to all the makers that every burner made had to go to Northampton, though they did not all get before the public, because some were too dear. His education and practice until he went to Manchester had been almost entirely in connection with Gas Companies who did fittings and everything connected with the supply of gas. He was for some years at Maidstone; and there they began early to take up the question of fittings and the supply of stoves. It was a remarkable fact that, when Mr. T. Newbigging obtained some statistics a few years ago as to the daily and nightly consumption of gas in various towns throughout England, it came out that Northampton and Maidstone distributed a larger percentage of gas in the daytime than any other Companies or Corporations in the United Kingdom—simply because they had been supplying gas-stoves from a very early period. He was pleased to say that consumers would, as a rule, if properly treated and shown the best things, have them. He agreed somewhat with Mr. Tobey, that they should not give things away. The Electric Light Companies did not give electric glow-lamps away; but still, if consumers would not have new gas-burners without, he would give one away occasionally. He did not believe in letting out gas-stoves until recently, as he thought it best for consumers to purchase them. But now he would recommend every Corporation and Company to take up this question of fittings and burners, and the selling and letting-out of stoves. He did not agree with all that had been said about dry gas-meters; and having to buy a meter for himself the other day, he purchased a wet one, for he believed in wet meters, though there certainly were good dry ones. There were no doubt good makers of every kind now. At Northampton, the cost for meter repairs was very little indeed; and the leakage was also exceedingly small. The wet meter was the most accurate machine devised, and not so liable to be disarranged as the dry one; but it had to be put in a proper place. It ought to be fixed in a cellar where neither frost nor heat would affect it; and then there would be no jumping of the lights, which was generally caused by the condensation of vapour from the overheating of the water in the meter. He thought everyone should take up this matter, which was a very interesting one. He had enjoyed hours and days in testing burners just for the pleasure of the thing—as a matter of science. Although it would entail a certain amount of trouble, it was a labour of love, and would be a benefit to themselves, the consumers, and the companies or corporations with whom they were connected.

Mr. Helps said at Bath they were not very far behind Northampton. When his friend, Mr. Warner, was with him at Bath, about 38 years ago, he made a gas-stove, and had a dinner cooked by it at his house, to which the Mayor and some members of the Corporation and the Press were invited; and a little pamphlet on the subject was then compiled and distributed.

Mr. West said all these points showed the importance of the Institute. Many of their friends in former days had no opportunity of discussing these points or knowing their importance. He had thought that now for many years every company and corporation were doing gas-fittings, the same as they were at Northampton—in fact, he did not know the contrary until attending a meeting recently in London.

Mr. T. N. Ritson (Kendal) remarked that the defects in gas-fittings were sometimes due to architects. They made plans for large buildings, and specified pipes of certain dimensions—frequently several sizes too small—and never asked the opinion of the gas authorities. Then again architects were in the habit of supplying fittings simply because they obtained commission upon them, which he did not think was fair to the gas companies and gas-fitters. When he was in Jersey, there was a church built; and the architect, of course, issued a specification. But, instead of employing Jersey labour, he sent over gas-fitters from London; and anybody who ever had any experience of London gas-fitters knew somewhat of their capabilities. In this building, which was some 60 feet high, the architect took an inch pipe along the top, with ½-inch down-rods (about 20 feet long) and star lights; and, to make matters worse, stuck them right in the middle of the columns instead of the middle of the arches. The result was that, when the gas was connected up, the lighting was a miserable failure. It must be very nice for gas companies and corporations who possessed a monopoly. But, unfortunately, a large number of the smaller companies had to compete with gas-fitters and plumbers in the various towns; and, as a great deal of small cottage property was let by contract, they had considerable difficulty in competing with those men, because they would put in very small pipes, and employ cheap labour, which the gas company would not do. For a good supply of gas, the pipes must be of adequate size, so as to supply it at the minimum pressure, as Dr. Macadam had so well shown. If the pipes were large enough to facilitate the flow of the gas, not only was leakage minimized, but the light was improved. It would be a good thing if gas companies could induce architects to co-operate with them; and, if this were so, many complaints of bad gas would be avoided.

Mr. T. Duxbury (Darwen) said that the question of the control of pipes, &c., by gas managers had been discussed for many years at meetings of the Institute. He was rather inclined to believe with Mr. Tobey that they, as gas managers, were often misunderstood; and that the advice given was not taken, because people had not confidence in them. He had found it so himself. If Mr. West, when he was at Northampton, had a monopoly in gas-fitting, he thought he was very foolish to give it up, and allow the plumbers to do it themselves. If he (Mr. Duxbury) had such a monopoly, he should not throw it up by any means. He remembered an occasion, some time ago, of a mill-owner in his own town who complained about his gas; the quality then supplied being 17·68 candles. He (Mr. Duxbury) went to his place, and asked him to select from his mill four burners—one bad, one good, and two medium. He took the burners away, and tested them; and he found that this man was simply getting, from 17·68-candle gas, the light of 7·06 candles on the average. His bill was upwards of £100 a year; and he was losing quite 76 per cent. of the light. In other words, he might have had the light he was getting for about one-fourth of the same money. He (Mr. Duxbury) explained to him that he could have renewed his burners 28 times a year with the money he would have saved. He was a Justice of the Peace,

and a Town Councillor; but his successors at the present day were going on in the old way—using little iron burners which had been on for ten or twelve years, only changing odd ones as they became very bad. This was the sort of thing they had constantly to contend with; and until they had some control over the burners and fittings, he was afraid there would be a repetition of the same thing. Then there was the itinerant burner vendor. He remembered on one occasion a man selling burners in his own town. He came to his back door with a burner, and said he would guarantee he could save him 75 or 80 per cent. of his gas bill if he would buy the burner. The higher-priced burner he had, the more gas he would save. He told him eventually that immediately he touched 100 per cent. he could come and see him. With respect to architects, some time ago he prepared a code of sizes of pipes for different numbers of burners, and supplied it to architects in his own town; and fortunately they were adopted in all specifications. Now they put in a stipulation that the size of pipe and burner must be as specified by the Gas Committee, or the Gas Department of the Corporation; and this avoided any difficulty where respectable architects were engaged. Mr. Valon blamed the gas companies and corporations rather than the gas-fitters and consumers. There he should be inclined to disagree with him; because, try as they might, they found the same difficulty cropping up day after day and week after week. In his own town, he had no such difficulty as Mr. Valon had experienced, of houses being built without having any gas-fittings put in. No matter how poor or small the house, even the worst "jerry" builders provided gas-fittings—of one kind or another; so that they had never to put them in themselves. This work was always done for them, though it was often done indifferently.

Mr. C. S. Ellery (Bath) remarked that he understood Dr. Macadam to say that, in testing a No. 8 burner, when he reduced the pressure until the consumption was brought down as low as 3 cubic feet an hour, there was still almost the same amount of illuminating power. If this meant that the rate of consumption of gas could be reduced by some 50 per cent. or more, and still maintain a perfect flame without material loss of illuminating power, he doubted the correctness of the conclusions. Mr. West seemed a little dazzled with his own light. He would not have referred to this subject, except that he thought Mr. Valon was misunderstood. It was not that he claimed to be the first to introduce making or hiring stoves and fittings, but the first to supply fittings free of cost, which was a very different matter, and, as he understood it, a very forward policy—perhaps too forward for some companies to adopt; but, in the case of Ramsgate, it was evidently one which answered admirably. He was rather struck with one point in the first paper read, in which the writer spoke with unqualified praise of compo. pipe as being practically everlasting. He thought this should be taken rather guardedly, because there were such things as rats and mice; and his experience was that they were fond of compo. pipes. Another practical point was that these pipes were often too near places where nails were driven in. Either an iron pipe should be put where nails were likely to be used, or the compo. pipes should be laid so low that the nails used in the floor-boards could not come in contact with them, otherwise he feared the work would not be everlasting. Sometimes a pipe was carried through a chimney and melted with the heat. He did not like to pass on without giving expression to his opinion that there was a great difference between an electric light company giving away incandescent lamps and a gas company giving away burners. If the inspector went into a shop where a consumer was using gas wastefully, without satisfaction to the company or the consumer, he might with advantage offer him a burner, and ask him to try the effect of using it in comparison with the old burners. This would be an ocular demonstration of the difference between good and bad burners, which it was certainly well worth while to afford.

Dr. Stevenson Macadam said he should regret if any misapprehension arose as to the meaning of any of the experimental results he had carried out. He endeavoured to make it perfectly clear that all the results to which he had referred were calculated to 5 cubic feet per hour. To be quite sure, he would give two of the figures—one when he was consuming 5 feet, and another when consuming 2·2 feet per hour. From the 5 feet he had 19·53-candle, and from the 2·2 feet 8·32-candle power; but then this calculated into 5 cubic feet gave him 18·91-candle power, or 97 per cent. of the original light.

The President asked if he understood Dr. Macadam to say that a diminution of pressure increased the light.

Dr. Macadam said it did not increase the light; but it kept it pretty much up to what it was. Calculating it to 5 cubic feet per hour, the total loss was only 3 per cent. of the light.

Mr. H. Ashton Hill (Wallasey) observed that there were not many papers this year, but they seemed to embrace the whole sphere of gas engineering, and could be discussed by any of the members; and he ventured to suggest that the Council should take into their serious consideration the question of furnishing copies of the papers to members a week before they left home, so that they might come better prepared to speak upon them. A good deal was often said as to what gas companies and corporations should do; but it was sometimes lost sight of that the engineer or manager was not the company or corporation, and could not always do as he wished. Some could do pretty much as they pleased; but others had not the same advantage. In dealing with the regulation of fittings, he was inclined to take a middle course. Some advocated one extreme—taking the whole control, and doing away altogether with plumbers and gas-fitters; but this would never do. He was more inclined to think they should have a system of regulation and bye-laws coupled with inspection. This was what he did with regard to both water and gas. He had found out only recently, in connection with the Corporation of Liverpool, that they were very chary about going too far and doing too much. Their inspectors would put on a washer, or any little thing of that sort, but would not undertake any serious repair, as they did not like to trespass on the plumber's domain. In the same way with gas-fittings, they had certain forms which the plumber had to fill up, stating the number of lights to be put on, in order that they might know the size of meters and pipes which would be allowed; and they declined to permit the gas to be turned on, unless the fittings were in accordance with their regulations. He had a stock of burners for giving away; and if a consumer complained, and could not be satisfied, he either gave him one, or sent a fitter to see him. In this way satisfaction was generally given. In regard to the material for pipes, in some towns they would have nothing but iron. In others—Liverpool, for instance—they would have nothing but lead pipes; each place giving reasons why they thought what they used was best. In his opinion, both were right enough if properly used and well protected. He had recently specified, in a new building he was erecting, that, where the pipes ran in walls, there should be half an inch of good cement rendering, to prevent the knocking of nails into the pipes.

Mr. H. Lees (Hexham) observed that, whenever the present subject came up for discussion, the most prominent place was given to burners, and the question of giving them away; but it appeared to him to be very indefinite as to what giving away good burners really meant. Some time ago he had to visit a place where they gave burners away—being noted much for their enterprise; but he was astonished to find, on making inquiries, that these burners were No. 6 and No. 8. There was, no doubt, a certain amount of enterprise in that; but they could scarcely class these as being the most suitable burners, from a consumer's standpoint. Were they to understand that it meant giving away penny burners? If so, there was not very much generosity about it. If they were recommending the best burners, they should not go below governor burners, and the best of the class. The question of regenerative burners was mentioned in one of the papers; but no speaker had touched upon it—the reason perhaps being that these burners had not yet come into anything like general use. There was no doubt they were much improved. His experience, however, had not led him to advance much in this direction; and small companies, of course, could not afford to buy regenerative lamps with the view of adopting them in a town, when they did not always turn out a success. The greatest failing he had found with regard to these lamps was the governor; and if a better one could be applied, much more satisfactory results would likely be achieved. India-rubber tubing was also referred to in one paper. It might not be thought necessary to say anything about it, but when they found that nearly every week gas companies were adopting the system of letting out

gas-fittings on hire, as inaugurated by Mr. Valon, and saw that they supplied a griller or a boiling-ring which was connected by means of rubber tubing, he thought some remark should be made upon it. They should be very careful, in introducing these appliances, to see that they were connected in a proper way. An india-rubber tube might be all right when it was first fixed; but after a time it became porous. With reference to the wet meter, he was surprised that Mr. Lyne should denounce it so thoroughly after having first given it a blessing; but he said the reasons it should not be adopted were well known—the principal one being that the light might suddenly go out. In his experience, all these meters required was regular attention. He had now charge of an undertaking where there were not more than two or three of them in use; but the reason for this was obvious. They had not the control of the gas-fittings, nor had it become a branch of their business; but where the company had it, he should scarcely have expected such a remark with reference to the wet meter. Speaking generally, he had never found any difficulty with regard to advising consumers. The only case he remembered was where a consumer had bought, at a somewhat extravagant price, a lot of burners from an itinerant burner man; and, after he had purchased them, he saw the man converting ordinary brass burners into these patent burners at 6d. and 1s. each. Since then he had had a suspicion of everyone who recommended a good burner. With this exception, his experience led him to the conclusion that the more managers came into contact with consumers, the better it would be.

Mr. James Braddock (Radcliffe) said he should like to ask the reader of the first paper a question. Seeing that he had been engaged in gas-fitting in the town he represented for so long a time, it would be a fair inference that he had fitted up a good proportion of the property in the neighbourhood. He should like to know, therefore, what influence he attributed to it in the way of a reduction in the initial pressure at which he was enabled to distribute his gas. If he could state what it was, and what it would otherwise have to be, it would be useful information. He (Mr. Braddock) should like to emphasize the recommendation that india-rubber connections to gas-fires and the like should be utterly abandoned. He considered their use was a most unworkmanlike proceeding, and one absolutely dangerous. On the question of wet meters, he would content himself with saying that his experience must have been different to that of the author's, as they had arrived at opposite conclusions. On the general question of fitting up houses by gas companies and corporations, he was entirely at one with the author. He thought the time had now arrived when leaving the matter to architects and local gas-fitters should be abandoned.

The President said they had had a most interesting discussion on two very practical papers; and he would only detain the meeting with a little of his own experience. There had been some discussion as to whether iron pipes or composition ones should be used. When asked this question by architects, he always suggested that horizontal pipes laid under floors should be of iron; but for vertical pipes, he much preferred composition. In cases, however, where vertical iron pipes were laid, then the angle between the horizontal and vertical should not be carried out by a simple wrought-iron bend, but by a T-piece, leaving a plug in the bottom. In a vertical pipe, there was a great tendency to accumulations of rust, which would fall to the bend and stop the supply, whereas if a T-piece were put on, with a plug below, it was easy by taking out the plug to clear the pipe. However, he preferred generally composition or lead for vertical pipes. They were not so likely to be attacked by rats in that position as when under the floors. With respect to horizontal pipes under floors, there was another evil effect besides the attentions paid to them by rats, who seemed fond of eating them, for he had sometimes found several inches of lead pipe eaten away. If the points of support between the pipes were too far asunder, and the pipes were weak, there was a slight curve; and if at any time water from the meter or other cause got into the fittings, it collected in these curves, and so affected the supply. This would not occur with horizontal pipes, if sufficiently strong. With regard to the interference of gas companies with fittings and burners, two examples were before them—one of old standing by water companies, who would not supply water to any house unless the fittings were previously examined and approved by their fitters, so as to prevent unnecessary waste. He knew of places where 50 or 60 gallons of water were used per head of the population, and where he was quite sure that 20 or 25 gallons would be sufficient; but that was in a place where they had not that proper supervision over the water-pipes they should have. Another example was that afforded by electrical engineers. They now generally adopted the rules of the Phœnix Fire Office, and would not put on an electrical connection to a house (principally on account of the danger by fire), unless the wiring and fittings were carried out according to well-ascertained rules. All they had to do, therefore, with regard to gas pipes and fittings was to imitate the good example of their elder brethren the water engineers, and their younger brethren the electrical engineers. With respect to the consumption of gas at the burner, he happened to make a remark in the course of his address which he thought touched many causes of bad lights. A great many burners were practically Bunsen burners; because out of a very small orifice, the gas was allowed to escape at a high velocity. It caused a current of convection exactly in the same way as a steam-jet from a locomotive; and it carried air with it, which would mix with the gas, and reduce the illuminating power. Probably Dr. Macadam would agree with him that, in nine cases out of ten, burners were defective from there being too high a velocity in the gas issuing from the aperture. Another matter had been alluded to by Mr. Travers, as to the pressure of the gas. If there were not governors to the burners, there should be some arrangement made—because a burner which would be suitable for high pressure would not be best for low pressure. Some duplex burners were made to reduce the pressure; and in some of them there was a small aperture below, and a larger one above, thereby diminishing the velocity of the gas at the time it met the air. Another matter referred to was the use of india-rubber tubing. The connection did not seem to be very close between india-rubber tubing and chocolate; but chocolate had been defined by an eminent French chemist as an alimentary paste, which contained everything, *even cocoa*. In the same way, he had told manufacturers of india-rubber pipes that these articles were compositions which contained almost everything, even caoutchouc. He believed that some samples contained 75 per cent. of French chalk, or other adulterant of that kind; and, therefore, some of the evils attributed to india-rubber pipe might arise, not from the fact of it being india-rubber pipe, but from the fact that it was not—especially as the deterioration in some of these mixed samples was extremely rapid. At the same time, he quite agreed with the general opinion that even the best india-rubber, on account of its weakness and tendency to be perforated, should not be used in any place where heat or friction was likely to damage it.

Mr. Lyne, in reply, said he had not found any fault with the wet meter as a measure, having only condemned it, from a gas consumer's point of view, on account of the inconvenience it caused. Even Mr. Helps, who was the strongest champion of the wet meter, had to resort to a dry one when he removed into another house, owing, as he stated, to bad fittings—that was to say, pipes badly laid; thus proving that the only remedy in such a case was a dry meter. Other defenders of the wet meter had averred that, if it was properly attended to, no sudden extinction of lights could take place. There was always "much virtue in an 'if.'" But did wet meters always receive proper attention? Any person who had had sufficiently long experience in the matter knew well that, even with the best attention, sudden extinction of lights would take place too frequently when wet meters were employed. No amount of attention on the part of the manager of a gas undertaking would prevent minute leaks from developing in the float, U-tube, waste-box, or outer case; and any little leak of this kind was certain to result in sudden darkness without warning. He should not himself like to be present in a private house, and still less in a public room, when such a thing occurred. Mr. Valon had stated that his Gas Committee were supplying fittings free of charge to small consumers; and he afterwards explained that they were charged 7d. more per 1000 cubic feet for the gas they used. This might be a very good thing to do; but it was rather surprising that a man usually so accurate as Mr. Valon was should describe this as supplying the fittings free. The President urged that it would be a good plan to lay iron pipes horizontally under floors, and composition

pipes vertically. He (Mr. Lyne) was sorry to differ from the President, but this combination of piping would be about the worst possible; and, if Mr. Lane had had the smallest practical experience in the matter, he would be the first to condemn it. Composition pipe had been objected to by some of the speakers on the ground that it was liable to be destroyed by rats and mice. He was aware of that. It was usual now to recommend gas consumers to keep the supply constantly on; and if this were done, the smallest puncture made by a rat or a mouse would allow gas to escape, and this would prevent any further inroad. It was much the safer plan to keep the gas always on, as the slightest leak would soon be detected by persons going about a house. Many speakers seemed to think that consumers would look with suspicion on a free gift of burners. There was a time, now long past, when the "gas-burner man" used to pay visits to Wexford. The gas consumers very soon found out that the burners supplied free by the Gas Company were far superior to those they bought at from 4d. to 1s. each; and the "burner man" had to discontinue his visits. The consumers had long ago been educated up to the fact that a good burner, passing from 6 to 7 cubic feet of gas per hour, would give them better value in light than two equally good, but smaller burners, passing only 3 to 3½ cubic feet each in the same time. His Company gave small burners when these were asked for, and, of course, large ones if wanted. They forced nothing, dictated nothing—simply contenting themselves with giving advice; and this advice was never looked upon with suspicion, but was always received thankfully. They took care to supply only good burners. If the pressure in a district was considered high, regulator burners were supplied. Burners of this kind were not much needed, as the pressures over nearly the whole district (with a population of 12,000) were usually what would be considered low. Where they were not high, a simple burner, provided it was of proper construction and of the right type, was as good as a regulator one. In reply to Mr. Braddock, he would say that the initial pressure seldom exceeded 1½ inches. It gave him no small pleasure to see that the relations of the gas undertaking he represented with its customers were very much better than they were in some other places, as far as he could gather from the remarks that had been made. If the close contact which would result from the supply of fittings, as he had urged in his paper, existed, a better state of feeling between producer and customer would be brought about. He felt thankful to the members who had taken part in the discussion.

PAPERS READ AT THE MEETING.

(*Continued from p.* 1153.)

ROTARY ENGINES AND THEIR APPLICATION TO GAS EXHAUSTION.

By E. Bryan Donkin.

Rotary engines bave been designed in such an innumerable variety of forms that it would be impossible, in a paper of ordinary length, to enter into the details of construction of one-tenth of the most important ones only. It is therefore proposed to confine the remarks to the particular types which have more especially been used for gas exhausting.

The simplest of these—and no doubt the oldest type of rotary engine—is that which derives its action from the steam impinging direct upon the atmosphere, as in the engine proposed by Hero two thousand years ago, or upon blades or vanes, on the principle of the water-wheel or turbine. The latter engines have been known for centuries; but on account of their extreme wastefulness of steam, they have not been adopted in practice. It has, however, now been proved that a steam turbine made on scientific principles will work economically; and Parson's latest steam turbine may be considered as a very good example of practical success from this point of view. Blast and exhaust fans (fig. 1) are on this principle, and have been used for exhausting gas. Another type may best be described as two toothed wheels gearing together, and steam impinging upon the teeth, which are in contact—the wheels being boxed in, to prevent the escape of steam in other directions (fig. 2). From this primitive idea have sprung several hundred inventions, the shape and number of the teeth being varied; but all are on the principle of one or more wheels gearing together, and revolving on parallel axes in a casing. Hence the term "chamber wheel gearing" is applied to this type, the best known examples of which for gas exhausting are the Jones exhauster and Roots exhauster; but the principle was described in books on mechanics over 250 years ago, and a patent obtained by Ridge in 1791 (fig. 3). The type shown by figs. 4 and 5 has a cylinder revolving either concentrically or eccentrically in an outer casing; and flap-valves are moved either by the drum itself or by levers connected with it. In many of the designs on this principle, the cylinders are not circular; and slides are often used instead of flap-valves. This type is hardly worth consideration, for purposes of exhausting gas; but small steam-engines constructed on this principle have been made to work. It is almost impossible to conceive two metallic surfaces coming into sudden contact many times a minute, without much noise and great wear and tear. A pump of this type (fig. 4) is mentioned in a work of mathematics dated 1588, and fig. 5 was patented by Dundonald in 1833. The type shown by fig. 6 has a disc, rolling round two conical plates in a spherical or semi-spherical casing, and known as a "Disc" engine. Many of these machines worked well for years as steam-engines, though rather uneconomical. Two of them were at work for several years as gas-exhausters at the Chartered Gas Company's old station at Horseferry Road, Westminster. It is doubtful whether this type was designed previous to this century.

Fig. 7 has a cylinder, rotating in an outer casing, and carrying round a slide or slides, the ends of which are in contact with the inside of the external casing. This type is very old; and there is not any vast difference between that designed by Ramella in 1588 (fig. 7) and fig. 8, patented by Josiah Beale in 1848. Fig. 10 shows a rotary steam-engine patented in 1838, and since as a gas-exhauster. Almost the whole capacity of the casing is utilized, but the pulsation would be very great; and the fact of the slides being totally unbalanced, and each having to practically stop once in a revolution, renders it unlikely to work well. Fig. 11 is on the same principle; and also utilizes nearly the whole capacity of the casing. The pulsation is not great with an exhauster on this principle, as the slide moves nearly at a constant velocity; but the machine only worked quietly and well at low speeds, the parts being much out of balance.

One great idea of inventors of rotary engines has been that, by doing away with the crank of the reciprocating engine on to which the pressure of steam is transmitted at a varying angle, great power would be saved. This is, however, now well known to be a fallacy. Nevertheless, a rotary engine would have much in its favour could it be designed to work with economy, and be constructed at a moderate price, while still maintaining the high efficiency for wear and tear that the best types have at present. Exhausters have worked constantly for as long a period as fourteen years, without being opened—*i.e.*, without any readjustment; but probably no one ever heard of a steam-engine running much over a year continuously without requiring some repairs or adjustment. It must be remembered that fourteen years' work as a gas-exhauster, generally means double this time when compared with the majority of machines.

It may be interesting to note the reason of such machines being a practical failure as steam-engines, and a complete success as gas-exhausters. The greatest difficulty experienced in this type of engine is getting a steam-tight joint between the slide or piston and the casing or other parts it has to work against. Thus, if fig. 9 is examined, it will be seen that steam can leak under the internal cylinder at A and between the two end plates and the slide, between the top and bottom of the slide B B, and between the slide and the internal cylinder at C C. Now, to make these joints steam-tight, at least nine separate packing-pieces with strong springs would be required, as it is practically impossible to make a sliding joint even fairly steam-tight without pressure—especially as a certain amount of clearance must be allowed for the expansion of the metal. In practice, a number of packing-pieces as described would be fatal to the working of such an engine, as the danger of a breakdown would be so much increased. It is therefore necessary to construct it without these, and with as little clearance as possible; the result of this

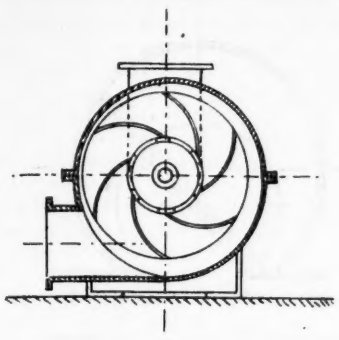


FIG. 1.

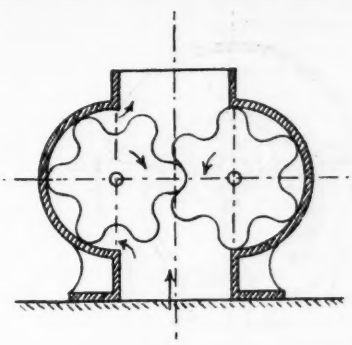


FIG. 2.

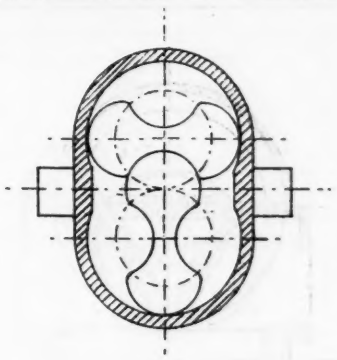


FIG. 3.

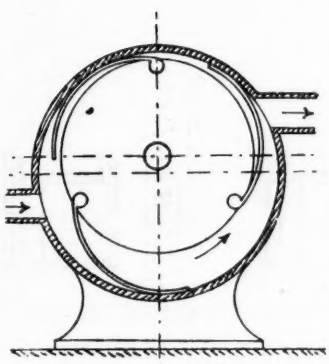


FIG. 4.

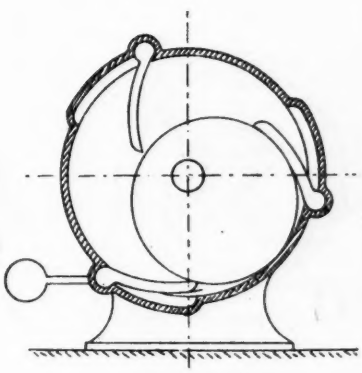


FIG. 5.

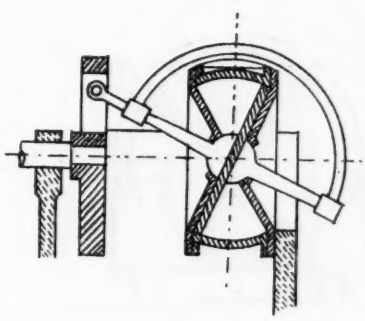


FIG. 6.

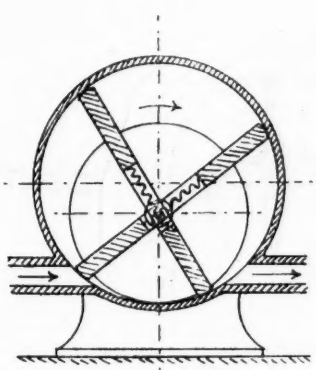


FIG. 7.

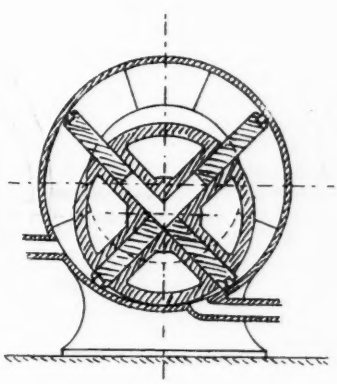


FIG. 8.

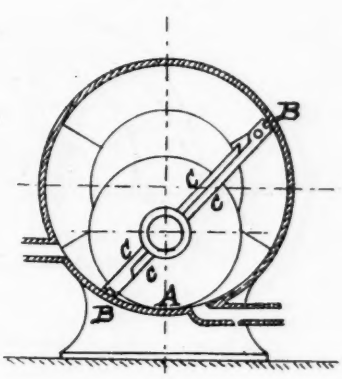


FIG. 9.

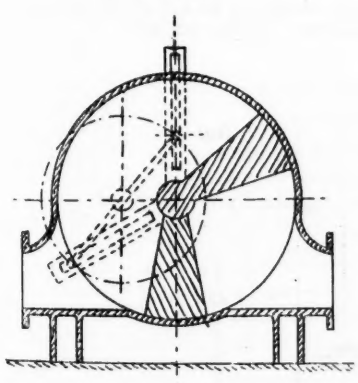


FIG. 10.

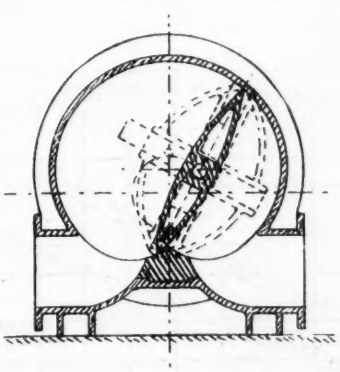


FIG. 11.

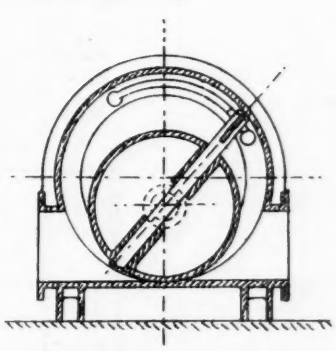


FIG. 12.

being great loss of steam. Take an engine, for example, 2 feet in internal diameter and 2 feet wide. Supposing the clearance at each joint was only 1-200th of an inch, this clearance would be equal to the area of a ¾-inch pipe; and steam blowing through this at (say) only 50 lbs. pressure, would be a very large proportion of the amount utilized as power. With the engine acting as a gas-exhauster, the pressure being only 1 to 1½ lbs., the amount of leak back or slip would be reduced to one-fifth or one-sixth of the leak of steam in the former case; and this would form a very small proportion of the gas passed, and represent a very small amount of extra steam required to drive the exhauster, as such extra amount would be used expansively in the engine driving the exhauster, instead of blowing off into the open air, as in the rotary engine. It is found in practice that the tar in gas-exhausters again diminishes the leak to a very considerable extent. The fact of the piston or slide opening and closing the gas

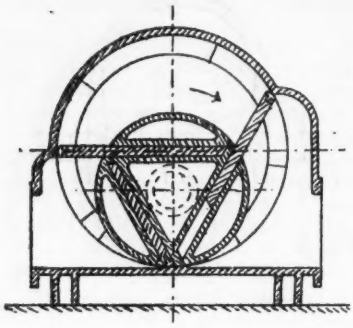


FIG 1

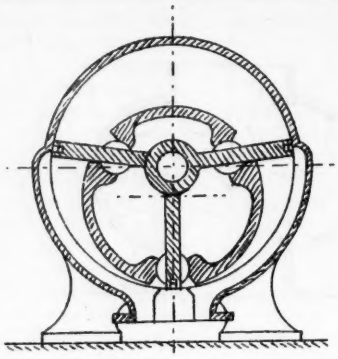


FIG. 14.

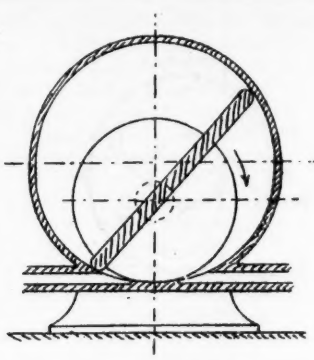


FIG. 15.

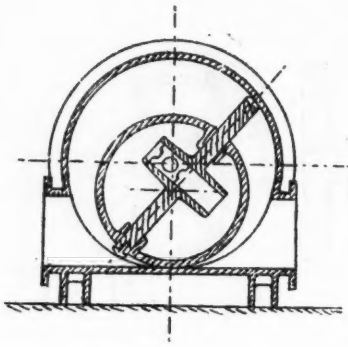


FIG. 16.

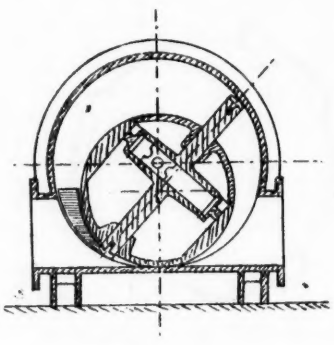


FIG. 17.

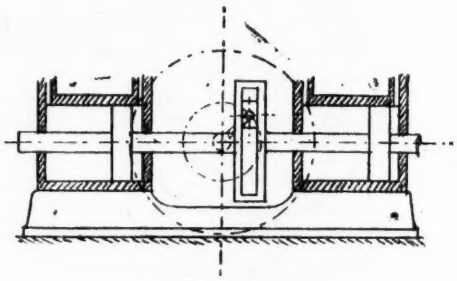


FIG. 18.

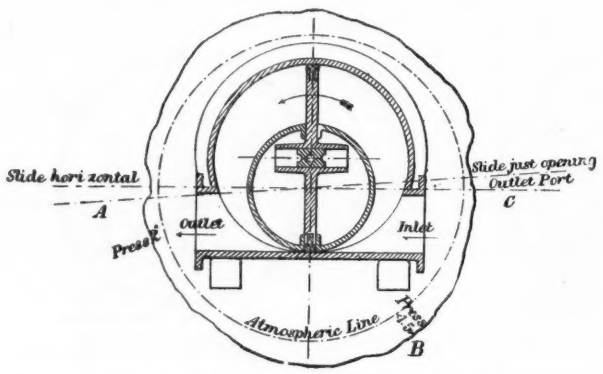


DIAGRAM NO. 1.—ORDINARY EXHAUSTER, 1877 PATTERN.
Pressure by Gauge, about 1 inch of Mercury;
Revolutions, 126 per minute.

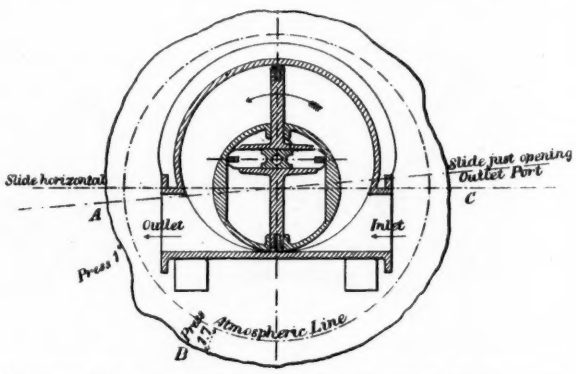


DIAGRAM NO. 2.—COMPOUND EXHAUSTER, 1892 PATTERN.
Pressure by Gauge, about 1·5 inches of Mercury;
Revolutions, 130 per minute.

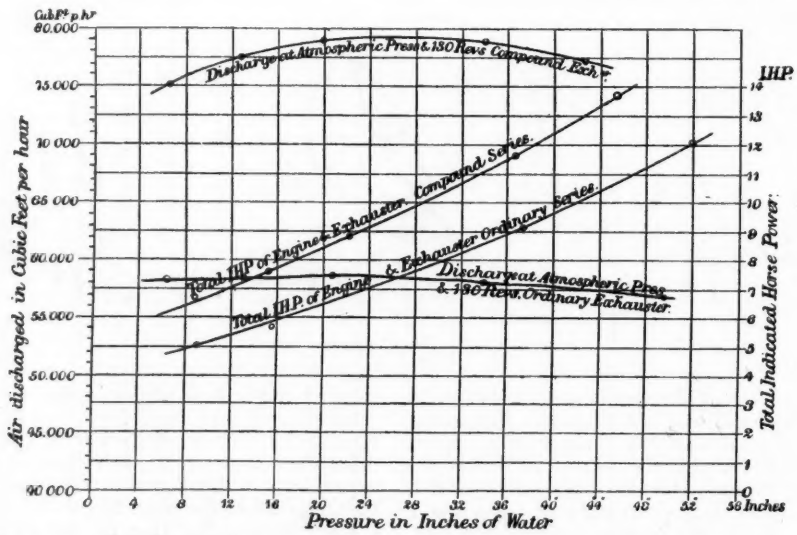

Cub Ft per hr
80.000
75.000
70.000
65.000
60.000
55.000
50.000
45.000
40.000
Air discharged in Cubic Feet per hour
IHP
Total Indicated Horse Power
Discharge at Atmospheric Press & 130 Revs Compound Exh.
Total IHP of Engine & Exhauster Compound Series
Total IHP of Engine & Exhauster Ordinary Series
Discharge at Atmospheric Press & 130 Revs Ordinary Exhauster
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 Inches
Pressure in Inches of Water

DIAGRAM NO. 3.—EXPERIMENTS ON 50,000 FEET EXHAUSTER, BY MR. HELPS.
[See Accompanying Table.]

Experiments on a 50,000 Cubic Feet Exhauster, conducted by Mr. J. W. Helps, of Croydon, Feb. 15, 1893.

Air Measured through circular holes in discs. Indicated horse power of engine alone, at 130 revolutions = 1·38. Barometer = 29·78 in.

No. of Experiment.	Revs. per Min.	Total I. H. P. Engine + Exhauster.	Mean Vacuum at Inlet. Inches of Water.	Mean Pressure at Outlet. Inches of Water.	Total Pressure = Vacuum + Pressure.	Area of Outlet. Sq. Feet.	Quantity of Air Discharged, in Cubic Feet per Hour.		Air Discharged, at Atmospheric Pressure, and 130 Revs. per Min. Cub. Ft. p. Hour.	Theoretical H.P. of Air Discharged.	Percentage Theoretical H.P. of Total H.P.	Difference between Total and Theoretical, H.P. in Percentage of Theoretical.	Diameter of Hole at Outlet. Inches.	
							At Speed of Expt.*	At 130 Revs. per. min.						
1	129·6	5·04	2·50	6·27	8·77	0·14806	57,220	57,400	58,280	1·317	26·1	283	5·21	Ordinary Exhauster, (1877 Patent). Calculated capacity = 55,554 cubic feet per hour at 130 revolutions per minute.
2	129·4	5·75	2·59	13·05	15·64	0·10084	56,230	56,490	58,310	2·311	40·2	149	4·30	
3	130·1	7·04	2·57	20·53	23·10	0·08000	55,950	55,900	58,730	3·393	48·2	107	3·83	
4	128·4	9·08	2·58	33·92	36·50	0·05867	52,750	53,410	57,880	5·054	55·6	80	3·28	
5	130·8	12·04	2·58	49·43	52·01	0·04715	51,170	50,850	57,060	6·986	58·0	73	2·94	
6	130·5	6·71	2·54	6·275	8·815	0·19180	74,170	73,880	75,030	1·716	25·6	291	5·93	Compound Exhauster. (1892 Patent). Calculated capacity = 79,000 cubic feet per hour at 130 revolutions per minute.
7	129·5	7·61	2·54	12·705	15·245	0·13582	74,730	75,010	77,360	2·990	39·3	154	4·99	
8	129·4	8·90	2·45	19·885	22·335	0·10900	75,020	75,370	79,070	4·398	49·4	102	4·47	
9	128·3 low.	11·64	2·48	33·91	36·390	0·08000	71,910	72,860	78,970	6·870	59·0	70	3·83	
10	123·2	13·70	2·42	42·86	45·280	0·06567	66,360	70,020	77,430	7·888	57·6	74	3·47	

* Theoretical velocity = $67\sqrt{h}$, where h = pressure in inches of water and velocity in feet per second.
Actual velocity, assuming ·64 coefficient = $42{\cdot}88\sqrt{h}$ = velocity in feet per second, or $2572{\cdot}8\sqrt{h}$ = feet per minute.
Discharge in cubic feet per hour = $154{,}368\sqrt{h} \times$ area in square feet.

inlet and outlet ports, so that no valves are required when used as an exhauster, gives an almost continuous flow, simplifies the machine, and makes it very suitable for the purpose.

The pump (fig. 7) invented by Ramella in 1588, as before mentioned, appears to be one of the earliest attempts in the construction of rotary pumps. It is certainly one of the best designs, as is shown by the fact that the most modern forms of exhausters are constructed on the same principle, but with various improvements in the details. One exhauster patented a few years ago was precisely the same in every respect; and several of them were made, and worked fairly well. The weak point of this design is that the internal surface of the casing has to guide the slides—*i.e.*, to force them in and out of the internal cylinder—causing great friction, and resulting in heavy wear and great absorption of power. If the slides of the pump are guided by segments running in circular grooves in the end plates, the friction is reduced; and Ramella's pump then becomes a Joshua Beale's 1848 patent exhauster (fig. 8) in every particular. Fig. 9, with two slides one overlapping the other, instead of four (as claimed by him in the same patent), is one of the most ordinary type now used. Mr. John Beale improved upon this design by making the slide in one piece, with a small additional slide working in it (fig. 12). The chief advantages of this patent are extra surface obtained in the internal cylinder, reducing the overhang of the slide when full out, and using rings instead of segments, increasing wearing surface and confining the friction to the inner circle only, whereas the segments are working one-half revolution on the inner circle and one-half on the outer circle. A very large number of these exhausters are in use. Mr. W. B. Wright's patent (fig. 13) is on the same principle; but as the slides enter the internal cylinder at a tangent, greater wearing surface can be obtained.

If the slides are guided from a central pin (fig. 14), it becomes Lord Cochrane's steam-engine, patented in 1831. This was again patented in 1855, by Belford, as a ventilator, and by many others since for steam-engines, pumps, blowers, and gas-exhausters. About 1860, Franchot, a Frenchman, designed an engine (fig. 15) in which the slide remained always the same length; and to do this, the cylinder had to be made greater in its horizontal than in its vertical diameter. It had the same defect as Ramella's —viz., the slide being guided by the inner surface of the casing. Mr. John Beale, however, got over this defect, by fixing a rotating block in the centre of the exhauster (fig. 16), carried on a horizontal fixed pin, and having two guides on the slide, which engage with the rotating block, and guide the slide independently of the casing. The chief improvement in this latter exhauster of Beale's is that the slide is guided from the centre of the exhauster, where the velocity is very low, instead of from the periphery, where the velocity is high; the difference being as 15 to 1 for the same number of revolutions. Besides this, a much greater surface for wear is obtained on the block than on the segments, and also more in the axle. The latest development in exhausters of this type (patented 1892) is utilizing the space occupied by the internal cylinder, as shown by fig. 17. This gives an increase of capacity of about 45 per cent. for the same size of exhauster at the same speed, without adding to the working parts. Another important advantage of this latter patent is the increased steadiness of gauge. It will be seen by fig. 16 that, while the slide in the casing is vertical, it is forcing out more gas than when in its horizontal position, thereby causing pulsation. But by utilizing the internal cylinder in the manner shown (fig. 17), its contents have hardly begun to be discharged during the period of maximum discharge of the main slide; and while this main slide is discharging its minimum, the internal cylinder is discharging its maximum.

Many efforts have been made, with more or less success, to obviate the pulsation caused by gas-exhausters—generally by increasing the number of slides. This certainly does away to a certain extent with the pulsation, as the puffs of gas come nearer together; and therefore the pressure has not time to fall so low. As a matter of fact, however, this pulsation is not so much due to these outward puffs of gas as is generally supposed, or by the sudden opening and shutting of the ports by the slide; but it is chiefly owing to the gas passing back from the

outlet into the exhauster when the slide has just opened the outlet-port. Looking at fig. 16, it will be seen that the gas in the exhauster when both ports are shut is really in a state of tension, due to the vacuum on the inlet side; the gas in the outlet being under pressure. Therefore, directly the slide moves down and opens the outlet-port, the gas under pressure passes back into the exhauster, where there is no pressure. This happens in all exhausters of this type, independently of the number of blades. With the new type of exhauster (1892 patent), fig. 17, it will be seen that, just at the moment the gas is passing back from the outlet into the exhauster, it is met by a stream of gas from the internal cylinder; and this to a great extent decreases pulsation. Diagrams Nos. 1 and 2, taken from an exhauster on each type, by a steam-engine indicator, clearly show that this happens in practice.

These diagrams were taken in the following manner: A disc of wood covered with paper was secured to the end of the crank-shaft of the engine, so that it revolved in a vertical plane; each revolution representing one revolution of the exhauster. A steam-engine indicator, with a very light spring, was placed in front of the disc, and connected by a pipe to the outlet of the exhauster. Before the cock admitting the pressure from the exhauster to the indicator was turned on, the pencil was placed against the revolving disc; and, of course, it described a circle, called on the diagram "Atmospheric Line." The pressure then being admitted to the indicator, and the pencil again brought to the disc, the curve showing the variation of pressure throughout the whole of one revolution was described. It will be seen that in Diagram No. 1, directly the slide opens the outlet-port, the pressure at A begins to decrease, until it reaches about ·2 inch pressure, which is due to the gas passing back from the outlet into the exhauster. As the slide moves round, the pressure again increases until it reaches B, which is about 1·5 inches pressure, and then gradually decreases as the slide forces out less gas.

In Diagram No. 2, as the slide opens, the pressure remains about the same, because the full capacity of the internal cylinder is being discharged. It then drops, but only to about 1 inch pressure. It again rises to about 1·5 inches; and keeps averaging the same till the slide closes, the line much more nearly approximating a circle than in Diagram No. 1. The maximum pressure in No. 1 diagram being 1·5 inches and the minimum 0·2 inch, the difference is 1·3 inches, or 650 per cent. increase of pressure in each half revolution; whereas, in Diagram No. 2, the difference of pressure is 0·5 inch, or 50 per cent. increase only.

Apparently, the proper principle to obtain steadiness of gauge, would be to have a swing retaining-valve in the outlet-port of the exhauster, fitting against the slide; so that the latter would not open the outlet-port until the gas was compressed in the exhauster itself to an equal pressure with the gas in the outlet. It is, however, unnecessary in practice to go into such refinements, as the outlet gauge of modern exhausters is usually quite steady enough for the purposes required in gas-works; and it is the inlet or vacuum gauge which is the more important. In the table of experiments made by Mr. J. W. Helps, of Croydon, it will be seen that the pulsation shown by the inlet-gauge of this new exhauster is reduced to a minimum, due to the reasons just given for the increased steadiness of the outlet-gauge.

Bye-passing gas from the outlet to the inlet, both in the exhauster itself and outside, has often been resorted to to decrease the pulsation; but to have any very marked effect, at least one-third of the gas must be bye-passed. This means doing one-third of the work twice over, or, in other words, using 33 per cent. more steam or fuel than necessary, and increasing the wear and tear of the exhauster in proportion. Consequently it may be considered a very clumsy way of getting over the difficulty. Besides this, bye-passing has a great drawback—viz., churning up the gas in the exhauster, leaving hard pitch in the working parts, and causing the solvent properties of the tar to be carried away with the gas; thus ruining the exhauster, generating heat, and absorbing power uselessly. It may here be remarked that, where trouble is experienced from the formation of pitch, a small quantity of paraffin may be pumped into the exhauster now and then, and always before starting or stopping the machine.

Some of the movements in these rotary engines may appear complicated; but the study of mechanics greatly helps a practical man in working out such movements. For example, if fig. 18 (a well-known form of pump and engine combined) is examined, and compared with the exhauster in fig. 16, it would probably not be noticed that there was any connection between the movements of the two—one appearing much simpler than the other—and it would take some time and trouble to trace the connection. But a slight knowledge of kinematics would enable the symbols used to be applied; and it would be found that the symbol is the same for the chain of movements of both machines. It is easy to show the connection practically by a moving diagram, in which it is merely necessary to fix the crank-pin of a reciprocating engine and pump and allow the cylinders to rotate on a fixed centre, to give the motion of the exhauster (fig. 16). Probably most of the various motions in rotary engines of all types were designed with great labour and without the knowledge of kinematics, by the help of which the required motions could have been arrived at much more easily; and to this want of knowledge may no doubt be attributed the constant repetition of invention of engines that are in principle the same.

The lubrication of exhausters is a most important point, as affecting their working and wear. In cases where the tar keeps in a thinnish fluid state, an exhauster requires hardly any lubrication; but if the small amount of oil necessary is not of the right quality, the result may be that it will be stopped altogether, or some of the parts so worn that they will have to be repaired in a few months. The chief thing is to find out what particular oil mixes and works well with the tar which is being passed through the exhauster, as the tar itself, being a good lubricant (or rather, containing good lubricating ingredients), should be retained in the exhauster. The great object is to keep the tar in a soluble state; and in most cases it is found that the lubricant termed "coal tar" oil does this effectually.

In pumping clean gas, however, as is often done now, the "coal tar" oil has not sufficient lubricating properties; and any good machine oil can be used. But it must be one that will not congeal at a low temperature, as the gas is being pumped from the holders at very little above atmospheric temperature; nor must the oil contain any impurities that the gas will take up. Whether pumping foul or clean gas, the most important point, when a right oil is obtained, is to see that it is thoroughly filtered, so that no dirt gets into the exhauster with it, as is very often the case; the result being stoppage or increased wear.

Regarding steam-engines for driving exhausters, they should be as simple as possible, because in any case the engine is more liable to break down than the exhauster; and for the same reason, only high-class engines should be used. Single-cylinder engines are preferable, on account of their simplicity, fitted with a single slide valve and rod, and no expansion gear. This latter, besides making the engine complicated, is unnecessary, as the power is not varying every few minutes to any extent. Feed or other pumps should also be avoided on the engine. Horizontal engines are perhaps preferable, as with vertical ones there is a tendency for the water to leak through the stuffing-box of the piston-rod at the bottom of the cylinder, making it difficult to keep the engine clean. All the parts of a horizontal engine are also more accessible for lubricating, examining, and keeping clean; and there is less tendency to vibration than with a vertical engine. Where economy of steam and fuel is an object, the cylinder and its covers should be steam-jacketed with boiler steam, effecting a saving of 15 to 25 per cent. This question of steam-jacketing has always been a disputed point; but the economy is now proved. The jacketing must, however, be properly carried out; otherwise it may have the reverse effect. A steam-jacketed engine is also much easier and safer to start, as everything is warmer, which prevents an accumulation of water in the cylinder. If further economy is desired, the simplest plan is to have a separate jet condenser, air-pump, and engine (or an air and water surface condenser outside the house, with air-pump and engine); and to connect the exhaust-pipes of all the engines to this condenser. Then, by having two valves, the engine can be worked non-condensing or condensing at a moment's notice—doing away with the extra risk of a breakdown

with an air-pump driven direct from the engine, and yet being able to work with a maximum of economy. The air and water surface condensers do not require quite so much water as ordinary jet condensers. If the steam pressure available is 60 to 80 lbs., a simply-designed compound engine, to work either non-condensing or condensing, is very economical; but such engines are only advisable for driving exhausters of large size.

Those who take an interest in the construction of rotary engines, cannot do better than study Professor Kennedy's translation of Realeaux's "Kinematics of Machinery," which is probably the most interesting and comprehensive book written on this subject, and to which the author is indebted for some of the older examples of engines.

In conclusion, the author trusts that, notwithstanding the simplicity and unscientific character of this paper, it may throw some light upon the construction of the machinery which may fairly be called the "heart" of a gas-works. In writing it, he has been actuated by the hope that his personal experience on this subject may be of some value to the members of this Institute; and that the historical notes may prove of interest.

The Secretaryship of the Sunbury Gas Consumers' Company, Limited.—Mr. F. D. Sandell has been appointed Secretary of this Company in place of Mr. E. Sandell, who has resigned after many years' service.

The Directorate of the Canterbury Gas and Water Company.—The Directors of the Canterbury Gas and Water Company have elected Mr. G. J. Drury to fill the seat at the Board occupied by the late Colonel Horsley. There is, however, still a vacancy through the decease of Mr. R. Y. Fill.

The Gilchrist Lectures.—From September to December next, a number of lectures will be delivered in the Great Assembly Hall, Bethnal Green, in connection with the Gilchrist Trust. The series will be opened by Professor Vivian B. Lewes, who is to discourse on "The Atmosphere and its Relation to Life."

The Council of The Gas Institute, on the occasion of the recent meeting in Belfast (in accordance with Rule 41), appointed Mr Samuel Stewart, of Greenock, to the vacancy caused by the death of Mr. S. R. Ogden, of Blackburn. In this connection, it may be mentioned that it was Mr. James Braddock, of Radcliffe (not of Oldham), who was elected by ballot as a new member of Council.

Presentation to Mr. C. Chester.—On Thursday last, the employees of Messrs. F. C. Hills and Co., Chemical Works, Deptford, presented a beautiful gold watch to their foreman, Mr. C. Chester, who is retiring after filling that position for 28 years. The gift was accompanied by an address, in which reference was made to the esteem and respect in which Mr. Chester is held by all the men, and expression was given to their wishes that he might have many years of good health to enjoy his well-earned rest. The subscription-list contained 150 names.

The Sale of Fertilizers.—A Bill has lately been introduced by the Minister of Agriculture (the Right Hon. H. C. Gardner), in conjunction with the Lord Advocate and Mr. John Morley, with the object of giving effect to the recommendations of the Departmental Committee appointed by Mr. Chaplin last session to consider the whole subject of fertilizers and feeding stuffs. It is proposed in the present measure that every person who sells for use as a fertilizer of the soil any article manufactured in the United Kingdom, or manufactured abroad, shall give to the purchaser an invoice, stating, as nearly as possible, the percentage of the nitrogen, soluble and insoluble phosphates, and potash (if any) contained in the article; and this invoice is to have the same effect as a warranty. Provision is made for testing the fertilizer. The penalty for breach of the provisions of the proposed Act is a fine not exceeding £20 for a first offence, and not exceeding £50 for a subsequent offence.

The Auer Incandescent Gas-Light.—Dr. Polis has recently delivered a lecture before the Chemical Society of Aix-la-Chapelle on the Auer incandescent gas-light. He formed mantles of the oxides of the rare earths employed in the Welsbach system, as well as of certain mixtures of these oxides, and observed the differences in tint of the light emitted when they were raised to incandescence. The oxides were prepared, according to Dr. Auer's method, from the pure nitrates; and it was rendered evident that any shade of colour, from the purest white to the rich gold tint of the electric glow lamp, could be obtained by judicious selection and admixture of the earths. The unalterable character and infusibility of the latter were proved by keeping some of the finely powdered material at a white heat, by means of oxyhydrogen blowpipe, for two hours, at the end of which time no alteration or loss of weight had taken place. M. Kowarzik, in the *Photographische Mittheilungen*, recommends the employment of the Auer gas-light for taking copies of negatives; and he gives the duration of exposure required with different sensitized papers. He concludes that its cheapness should commend it as a substitute for the electric light for this purpose.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1228.)

THE revival of activity in the Stock Exchange, the commencement of which seemed fairly perceptible, made no progress whatever last week; in fact, things were as dull as they well could be. The excessive heat of the weather was sufficient to prostrate the energy of most; and no favourable incident occurred to restore it, except a beneficent lowering of the temperature. Business was almost at a standstill; the attendance generally was thin; and prices drooped for lack of support. The agricultural outlook has been amended by the moderate rain which has fallen in some localities, and fair anticipations of advantage to accrue from the Herschell Commission's report have been formed; but, beyond these, no bright ray relieved the gloom of the markets. Meanwhile, hopes are indulged in that matters will mend after this week's settlement. The Money Market continues in the same easy condition; and there is every reasonable prospect that so it will remain for some time to come. The Gas Market offers more cheerful matter for consideration than the rest. Although business has not been very active, the general position of gas securities as investments continues on its steady course of progress. The eyes of the public, long dazzled by the brilliancy of electrical prospectuses, are recovering sufficiently to distinguish the proportions of really sound commercial business done respectively by the two illuminants; and their vision recently must have been considerably cleared by the revelation afforded by the appeal of the City of London Electric Lighting Company for additional capital. Space will only permit us to commend this appeal to the careful perusal of all interested. Business was moderate and steady in Gaslight "A," which on Thursday and Friday touched 229, but on realization of profits was a point easier at the close. Among the secured and limited issues, nothing moved but the "H," which improved 1. South Metropolitans were quite unaltered; changing hands to a moderate extent at the old prices. Commercials were rather more brisk; and the old stock was done at 250—a level 5 per cent. for money. The Suburban and Provincial Companies share in the general advance—Brentford, British, Bromley, and Crystal Palace having all gone up in value. The Continentals are equally buoyant; European and Imperial being quoted higher. The South American contingent continue to do well; Buenos Ayres and Pará showing a rise. The Water Companies have been very quiet; and Kent is the only one to move—having gained 2.

The daily operations were: Gas opened strong on Monday; and, though not very active, made some fair advances. Gaslight "A" and Imperial Continental rose 1 each; and British, ½. Kent Water gained 2. Business was much quieter on Tuesday; but the flood-tide continued. Brentford old and Crystal Palace rose 3 each; Buenos Ayres debentures, 1½; Commercial old, 1; European, ½; and Pará, ¼. Wednesday's transactions were about on a level with the day before; and prices remained unchanged. On Thursday, quotations again closed without alteration; but everything dealt in was full of strength. Business was rather quieter on Friday; but quotations were improved by an advance of 1 in Gaslight "A," and ½ in Bromley. Saturday was as quiet as usual, and Gaslight "A" was put back by a point; but, *per contra*, the "H" 7 per cent. limited was advanced to a similar extent.

ELECTRIC LIGHTING MEMORANDA.

The Induction Committee at Work—The Case against Earth Return Circuits—Professor H. Robinson on the Cost of Central Stations.

THE Joint Committee of Lords and Commons appointed to consider and report whether the grant of statutory powers for the use of electrical currents ought to be qualified by the obligation to provide earth return circuits, and to carry responsibility for leakage, induction interference, and other matters, have commenced their labours, and a mass of evidence has been tendered by different parties interested in the subject. The peculiarity of the inquiry consists in its being a "cockpit" for various electrical interests; and the Committee will have to decide upon a disagreement of "doctors" of a particularly self-confident breed. The spectacle of electricians worrying one another is one to fill the outer world with unholy joy. These gentlemen have held their heads so high, and have lorded it so haughtily over persons of less scientific reputation, that the mutual horror and amazement with which one section of them has found itself at loggerheads with another, are vastly entertaining. When the Committee met, Sir Courtenay Boyle, the Permanent Secretary of the Board of Trade, who was the first witness, played the part of herald to the champions who were to follow. That is to say, he explained to the Committee how that for several years the telephone and telegraph companies (including the railway companies) have sought for protective clauses in electric lighting and electrical tramway

Orders and Bills; their object being to protect their circuits from interference by stronger currents than they themselves employ. The action of Parliament has not been uniform in this matter; and four different saving clauses have from time to time been adopted. It is the opinion of the Board of Trade that this question should now be settled; and the Committee are asked to lay down the amount of protection, if any, which telegraph and telephone companies are entitled to receive.

The gist of the case, as laid before the Committee by Sir Courtenay Boyle and Mr. W. H. Preece, is as follows: Telegraph and telephone companies habitually use the earth for their returns, and claim a prescriptive right to do so, which is reinforced by the fact that in so acting they do not harm anybody. On the other hand, both electric lighting and electrical traction companies have been strictly forbidden to use the earth for their returns, because this would set up a disturbance over a considerable area. The Board of Trade regulations also aim at preventing leakage from electrical tramway lines; but it is not possible to attain this object. In the case of the City and South London Electric Railway, although the earth is not designedly used for the return, yet the circuit is completed by means of the rails and tunnel tubes, and the result is a leakage which can be traced by its effects for miles. Mr. Preece stated that last year these disturbances began to increase; and his attention was called to the fact that in the Clapham Road there lives a chemist who has in his shop window an instrument for exhibiting the passing of every train on the electric railway—the instrument being connected on the one side with the gas-pipes, and on the other with water-pipes in the house. Mr. Preece observed that he had caused these currents to be measured, and they were found to be quite strong enough to light a lamp, or to ring one of the division bells of the House of Commons. Mr. Preece went on to say that "the electric pressure found between gas and water pipes was by far the most serious disturbance likely to be brought to their notice. The pipe connected with the positive side of the current would in course of time be decomposed, whether the pipe was iron or not." In view of the gravity of this statement, the Committee consented to an application by Mr. Pope, Q.C., that the gas and water companies should be represented before the Committee with reference to their special interest in the inquiry.

Professor Henry Robinson has contributed to the *Electrician* a useful commentary upon the actual conditions of electric light supply from central stations, which is designed to explain the nature of the various considerations that a consulting electrician has to pass in review in order to advise public authorities as to the most suitable system to be adopted for a particular district. This is very good of Professor Robinson, especially, as our contemporary remarks, since every attempt to hold the balance evenly between competing systems is sure to be attacked on one side or the other. As a matter of fact, however, the most elaborate disquisitions upon electric lighting systems are frequently indulged in by various experts, only to result in a fresh proof that the system with which the expert happens to be previously identified is far and away the best. We might trust an alternate-current man or a continuous-current man to prepare an "impartial" survey of the electric lighting practice of his time, and might rely upon his taking us through the whole range of the industry; but in the end his heart would be found "true to Poll." Professor Robinson tries to give some general data, relating to the cost of establishing central stations, which are deserving of attention. He remarks that the capacity of a station is stated in kilowatts—one kilowatt meaning the capacity for delivering one Board of Trade unit per hour to the lamps. One Board of Trade unit is capable of working a 16-candle incandescent lamp for 17 or 18 hours; consequently, the number of such lamps which a station can serve simultaneously is found by multiplying the number of kilowatts by 17 or 18. Thus a 300 kilowatt station will serve from 5100 to 5400 lamps of 16-candle power simultaneously, which will represent a gross lamp connection of from 6800 to 10,000 or more lamps, according to the character of the district. Professor Robinson gives several examples to show the most economical system to be had for different districts. With regard to the cost of central stations, Professor Robinson supplies a handy rule for the use of engineers called upon to give a summary approximate estimate, including everything. It runs to £2500 + £45 per kilowatt for the alternate-current system. For the continuous-current system it is taken at £2500 + £50 per kilowatt, with feeders averaging half a mile long. This is exclusive of distributing mains; and it is safer to leave out the land also. For the central station alone, including all capital and running charges and loss in distribution, Professor Robinson's rule agrees very well with the estimate of Dr. Hopkinson given in his Presidential Address to the Junior Engineering Society last November, when he took the cost of a 2500 kilowatt station without land at £120.000. Professor Robinson regards the two-wire system and alternate-current distribution by transformers in each house as obsolete, although the latter is still used by several companies in London "whose main object in adopting it was to obtain a hold over as large an area as possible with the minimum expenditure of capital." It is the Great American system, only in the towns of the United States the transformers are hung outside consumers' houses on the wire-carrying poles, instead of being brought indoors.

CHEAP GAS-ENGINE WORKING IN BELFAST.

In connection with the meeting of The Gas Institute, it should be recorded that an interesting and important illustration of the efficiency of gas-engines to compete in certain circumstances with steam-engines for ordinary mill work was afforded at the linen factory of Messrs. Thompson, Rogers, and Co., in Severn Street, Belfast. A general invitation was extended to members of the Institute attending the reading of Mr. Emerson Dowson's paper on "Gas Power," to visit this establishment, of which a few availed themselves, and were indebted to Mr. Thompson for a straightforward and satisfactory statement of his reasons for adopting gas-engines for driving his looms, and of the results of the experiment. At present there is one Tangye gas-engine of 100-horse power at work, supplied with gas from a Dowson producer; but it is stated that, as the demands upon the establishment (which is quite a new venture) increase, two more engines of the same size will be put down—a quite sufficient testimonial to the success of the experiment from the point of view of the power user. We feel it a duty to bring this matter prominently before our readers, because we have on more than one occasion recently expressed disappointment at the apparent backwardness of gas-engine makers, in confining themselves to machines of small power. Gas-engines of 100-horse power and even more have frequently been heard of, but seldom seen; and we commented sharply at the time upon the absence of anything of the kind from the last Crystal Palace Electrical Exhibition. Only last week, in making a few observations upon the address of Mr. Denny Lane to The Gas Institute, we adhered to the same line of criticism. It is only doing justice to Messrs. Tangye and the Dowson Economic Gas Company to make the fullest admission that, so far as the case of Messrs. Thompson, Rogers, and Co. is concerned, this criticism fails. Here we have an example of a gas-engine capable of indicating 100-horse power, that has been working every day for the past three or four months to the complete satisfaction of the owners, as supplied with Dowson gas from a generator consuming anthracite coal after the rate of 2½ tons per week, costing on the spot 20s. per ton. The necessary attendance is given by one handy man, whose wages are £1 per week; so that the special expenses of working under this system are £3 10s. per week. This, of course, is exclusive of wear and tear and interest on the Dowson part of the apparatus, which cannot amount to much. It is better not to put any hypothetical estimate upon this source of outlay, but to let the bare statement of working expenses stand on Mr. Thompson's authority.

Asked why the firm elected to use gas-engine power, Mr. Thompson replied simply: "To save money." The mill being quite a new one—indeed, it was stated that where the looms are now running and filling orders there was, six months ago, not one brick upon another—the firm naturally wanted to avail themselves of the newest and most economical source of motive power. They applied to Messrs. Tangye about a steam-engine, when the latter firm drew their attention to the possibilities of gas power; and this promised such economy in working, that it was soon decided to lay down the first unit of 100-horse power required to start the mill. There is now no question of resorting to steam for whatever additional power may be required. "We have started with gas," is Mr. Thompon's declaration; "and we mean to see the thing through. We are quite satisfied that we could not get from 75 to 100 horse power for ten hours a day by any other means for anything like the cost at which we are running the Tangye engine." The Dowson generator, it should be remarked, is considered large enough for another engine of the same size; for at present, with very easy stoking, at least one-third of the gas made is blown into the air.

The question may be asked: How does this plant compare with a coal gas supply? In the circumstances, the millowners are doubtless pursuing the cheapest plan; for, taking the consumption of coal gas by a Tangye engine of large size at 25 cubic feet per indicated horse power per hour, the consumption for 100-horse power for a working week of 56 hours would amount to 130,000 cubic feet, which at the lowest Belfast price of 2s. 3d. per 1000 cubic feet would cost £14 12s. 6d. There is plenty of margin between this figure and that of £3 10s. already given to pay for interest, wear and tear, depreciation, rent of space occupied by generator and check holder, and extra labour, and still leave a difference in favour of the Dowson gas. With regard to steam power, at the rate of 3 lbs. of coal per indicated horse power per hour, the consumption of a 100-horse power boiler would be 7½ tons per week; costing certainly between £6 and £7 on the spot. This supports our argument that nobody wanting 100-horse power and upwards will use engines supplied with coal gas at towns' prices, though, as now appears, there are places and conditions where Dowson gas-engines knock steam power out of competition.

At the same time, it must be remembered that these conditions do not always apply. Severn Street, Belfast, is a locality wherein a Dowson gas-producer can be set up and worked with impunity. It is not a highly objectional apparatus; but it would not be possible to use it everywhere. We shall not essay the delicate task of discriminating between the drawbacks and inconveniences of a steam-boiler and those appertaining to a Dowson gas-generator. These appliances have much in common. Both require stoking; both make

clinker and ashes; both take up room, and raise the question of insurance. The point as to which is the more convenient must be decided upon the merits of every case, even if it is to be admitted that the advantage of economy is on the side of the generator. We have been very glad to obtain Messrs. Thompson, Rogers, and Co.'s figures relating to the working of the Tangye-Dowson plant, which are all the more deserving of respect as they are not the result of trial running, but are based upon actual cash outlay covering several months. Curiously enough, the fuel consumption works out to exactly 1 lb. per indicated horse power per hour, if the engine is reckoned as running at full power—which it well might do, seeing that gas is so frequently being blown away. Upon the power actually used in the mill, however, the fuel consumption is about 1¼ lbs. per indicated horse power per hour—a sufficiently low average on which to congratulate the designers. It should also be put upon record, as an additional recommendation for gas-engines in mills, that the convenience of having the power in 100-horse power units enables it to be put down wherever required. This is a great consideration, since it means a saving of the cost and friction of the countershafting that in steam-driven mills runs away with a heavy proportion of the total power developed by the main engine.

NOTES.

An Improved Siemens Unit of Light.

It is well known that various attempts have been made to obtain a standard of light from hot or molten platinum. Violle proposed as a standard unit the amount of light radiated by one square centimetre of molten platinum, at the point of solidification. But, in order to keep the platinum unit uniform, the metal must be maintained absolutely pure, and its surface clean and smooth, which would involve melting large quantities of it in an electric furnace. The Siemens unit was proposed to be platinum foil at the instant of melting; but a series of 500 meltings gave deviations of 10 per cent. in the light emitted, in spite of the greatest precautions, mainly due to the tearing of the foil on melting. According to a recent report by the physicists of the Imperial Physico-Technical Institute of Berlin, attempts have been made to render the Siemens unit available for practical purposes, by fixing the temperature of the platinum in some way independent of its melting-point. It was found that, at any given temperature, the ratio of the total radiation to that transmitted by a layer of water of a certain thickness, was constant within 2 per cent. for platinum plates of different thicknesses and from different sources. The radiation was measured by a very delicate bolometer, constructed of a piece of platinum foil welded upon a piece of silver foil of ten times its thickness; the combination being rolled down to a thickness of 0·01 millimetre. It was then cut in a dividing machine, and the silver etched away from the strips, leaving the platinum foil only 0·001 millimetre thick. The Institute is at present engaged in determining the absorptive power of water and of the quartz vessel containing it. Some further important questions, respecting the effect of impurities in the platinum, and the best kind and duration of the incandescence, must be settled before the method can be regarded as put upon a practical basis.

The Permeability of Walls by Air.

It is sometimes stated, in connection with the lamentable disregard of ventilation by the builders of dwelling-houses, that some relief is afforded in this regard by the natural infiltration of air through the material substance of the walls. Some experiments bearing upon this point have recently been conducted by Dr. Serafini, of the Institute of Experimental Hygiene, in Rome, who has found, as might be expected, that the effect is very small. It was ascertained that the transmission of air through an area of one square metre of brick wall two feet thick, one-fifth part of which was composed of mortar, with a pressure on one side equal to 2 inches of water, was only after the rate of about 22 cubic feet per hour. Seeing that this pressure is equivalent to that of a high wind, travelling at the rate of 45 miles per hour, which is not often met with, and that one human being requires at least 2000 cubic feet of air per hour, the insufficiency of this suggested means of effecting a change in the air of an apartment becomes conspicuous. At the same time, it may be remarked that the thickness of the brickwork of most town houses in England is nearer 14 inches, or even 9 inches, than the thickness experimented upon by Dr. Serafini; and it is important to know the influence of differences of internal and external temperature in promoting infiltration of air through such walls, before the problem can be held to be settled.

Keeping Mortar from Freezing.

Many more or less satisfactory devices have been tried, with the object of enabling masonry and brickwork to be carried on in frosty weather; the most general method being the addition of salt to the water used for mixing the mortar or cement. M. Charles Rabut, Engineer of the Western Railway of France, states in the *Génie Civil* that, having tried admixtures of alcohol and marine salt with water for this purpose, he has finally adopted common soda, as giving the best and most uniformly reliable results in reducing the tendency of mortar to freeze. One pound of soda reckoned as anhydrous is added to a gallon of water; and this increases the cost of the masonry by about 1s. 6d. per cubic yard, which is an insignificant item in comparison to the saving effected in many cases through avoiding stoppage of work. It is admitted that the use of soda in this way causes a white efflorescence to appear upon the face of the work during the subsequent summer; but this disappears in the course of a few months. It may be remarked that the exceptionally dry weather of the present summer has brought out a good deal of white efflorescence upon new brickwork in this country, which was certainly not built in frosty weather by the aid of soda; so that a little more or less of the same phenomenon cannot make a great deal of difference in many localities. The cost of the soda treatment is taken from figures ruling in France; in England, it would be materially reduced.

COMMUNICATED ARTICLES.

THE SUGGESTED FEDERATION OF GAS MANAGERS' ASSOCIATIONS.

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

(*Concluded from p.* 1155.)

Some of the points already mentioned have received consideration in a paper read before one of the American Associations of Gas Managers by Mr. W. R. Addicks, who advocates the general merging of such societies in one, and that one to be worked on similar lines to the Society of Chemical Industry. He proposes that a kind of District Section should take the place of each District Association, affiliated to head-quarters, but retaining to some extent an independent position, particularly as regards local affairs. His aim is similar to that of the movers in favour of federation, and is a policy of steady progression rather than of revolutionary reform. He evidently considers that the United Association could retain all the advantages offered by existing ones, and that it would not be necessary to make any sacrifices whatever in order to secure the advantages of federation. This, I take it, is the view held by those who have originated the idea of a conference on the subject in England. And it is only by such a policy that any hope can be entertained of reconciling the conflicting elements that the friends of federation will have to encounter. Already, when the subject has gone no further than two modest resolutions, one in favour of federation and the other suggesting a conference, there are those who look suspiciously on the movement, as being actuated by motives which do not appear on the surface, or as being promoted for the advantage of particular cliques. If unworthy suggestions of this sort have power to interfere with a perfectly free and open-handed conference from the various Associations, then there is little chance of any agreement being arrived at. One of the chief objects to be borne in mind at the present time is that the proposed conference should consist of representatives free from bias or prejudice, anxious only for the advancement of the objects which led to the formation of the Societies in the first place.

Mr. Addicks also has some opinions on the matter of papers, both in regard to the selection of subjects and to the manner of treatment. He believes in careful indexing, so that any single fact, once published, should find its proper location where it can be produced when wanted; and after that there need be no repetition of the same point. If a paper on the same subject follows at a future time, it need not recapitulate the matter contained in its predecessors, but should take up the question just at the place where it had been left. It is obvious that, if one wishes to work up a subject, a good subject-matter index and a quiet evening in front of his book-shelves will enable much more work to be done than by taking a journey to a meeting, and listening to what may turn out to be a hurried reading and discussion. This point is especially emphasized if we assume that the subject-matter index is arranged to include, not the proceedings of one Association only, but those of all. It may be easy to apply to any one Association Mr. Addick's idea of one paper going on just where the other left off. But in the case of many Associations, all devoted to the consideration of similar objects, it is impossible to avoid a great deal of useless repetition as between one and another. Federation is the only means of avoiding such repetition.

Attempts of one kind or another in the direction of influencing the subjects selected by papers have already been made. For some years past The Gas Institute has followed the plan of sending out every spring a wide and comprehensive list of suitable subjects. The smaller Associations, in which the Committee are in touch with the whole body of members, usually manage to capture anything attractive, such as a new process that is being tried; and if any member happens to exhibit proclivities in any special line—chemical, financial, engineering, or administrative—he is soon brought to the knowledge of the Secretary, and is induced, by personal influence, to give a specimen of what he can do in the way of reading a paper, or rather of writing one, which is the more important part. The most obdurate cannot hold out many years before doing so. In America, it is a common practice

for a Committee to get together at a time well in advance of the meeting, draft out a list of subjects that seem appropriate to the present time, and then to "press gang" the best writer they know of as regards each topic. Sometimes they "strike oil" in so doing. It happens that the selected author has been working steadily on the question allotted to him, and has no reason or wish to withhold his conclusions from publication. But not unfrequently the result is a brief and weak-kneed paper, rich in imagination or recapitulation, but poor in fact, and a long way from the fulfilment of the conditions laid down by Mr. Addicks. One cause of the weak quality is the fact that too many papers are read in the course of a year. Under existing circumstances, it is impossible to avoid stop-gap papers, or to change their character, whatever may be the means employed for obtaining them.

The movement towards federation revives the hopes with which the inception of The Gas Institute was attended—such as the possible formation of a reference library, or even of a laboratory special to the Association, and a central "house of call" or head-quarters, affording to some extent the advantages of a club to visitors from the country. Systematic, competent, and exhaustive inquiries into various details of our industry that call for elucidation, and some attention to the editing of the Transactions, have also been suggested; and others have thought that The Gas Institute should take up the question of technical education. Of these and other matters that may suggest themselves, it is premature to speak until it has been seen whether there is any possibility of united action. The desire for a representative meeting is something more than a mere whim or chimera. It is an expression of the general wish for some improvement in respect to the matters above noticed, and for some extension of operations. We see future competitors gradually developing around us. Inventors of improved apparatus in the way of oil-lamps or electric lights seem to possess much more energy and enterprise than makers of gas appliances. Is it because their labours meet with a greater share of encouragement? Some few attempts have already been made in the way of prompting research and invention in respect to gas-stoves and gas-burners. Is it not possible to give a more solid and enduring stimulus in this direction than has been afforded by these comparatively feeble efforts? And yet some will argue that united action is not necessary, and that the present organizations are capable of doing all that can be done.

The endeavours of those to whom the consideration of a scheme for federation is entrusted must be directed to arousing the interest and co-operation of those who at present hold aloof; and the next thing must be an increase of pecuniary support. It would be invidious to analyze the finances of the Associations in a manner similar to that pursued in the case of members. But I think such an examination would exhibit a similar state of affairs. It would show that those who are ready with their time and talents have not been backward with their purses, and that the total sum expended per annum upon such matters as premiums for papers, costs of inquiry, prizes for inventors, and so forth, is a mere pittance as regards the magnitude of the interests involved. A considerable lump sum goes for stationery, printing, and incidentals, of which something like half might be saved by combination. The economy thus secured would leave a fund available for the purposes just indicated, that would represent no inconsiderable amount.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

(*Continued from p.* 1156.)

DISTRIBUTION.

Station Governors, Etc.

The special function of the station governor is to control the pressure at which the gas leaves the works, whether the district consumption be large or small. To effect this, the governor is fixed on the gasholder outlet main; and it intercepts the gas in its passage therefrom into the district mains. The necessity for such an instrument is due to certain varying conditions—on the works and on the district also—which, in its absence, would render the maintenance of a satisfactory pressure of gas in the mains an absolute impossibility. These are: The variations in the gasholder pressure (due to cupping and uncupping of the holders, to the particular holder delivering for the time being, and to other causes); and the draught on the main, which will depend upon the consumption on the district (this again being affected by the time of day, and by climatic and other conditions), and will call for more or less initial pressure according as the consumption increases or decreases.

The simplest form of station governor consists of an outer cylindrical tank, partially filled with water, in which floats an inverted bell or holder; the latter being actuated by the pressure of gas on the outlet main. The bell is counterbalanced, either by pulley-wheels, chains, and weights, or by an annular air chamber affixed around its bottom rim, or both. Suspended from the bell, and working in a suitable valve chamber beneath (through which the gas must pass), is a conical, parabolic, or slotted cylindrical valve, which rises and falls with the motions of the bell, and thus regulates the area of the gas-way in the valve orifice, in accordance with the position of the bell. If, therefore, the outlet pressure tends to drop, owing to increased consumption and a consequent greater draught on the main, its supporting power on the bell diminishes, and the latter descends, and with it the valve; thus slightly increasing the gas-way of the valve orifice, and admitting of the passage of a larger quantity of gas. Conversely, if the consumption be reducing, the pressure will tend to increase; and it will therefore raise the bell slightly, and close the governing valve accordingly.

The governor bell is thus kept in equilibrium by the pressure of gas on the one hand, and counterbalancing on the other. On the buoyancy of the bell will depend the pressure which the governor can give; and this may be varied at will. Supposing the governor has been weighted to give 20-10ths of an inch pressure. This will be maintained without deviation as long as the gasholder pressure is sufficient to keep up the necessary flow of gas; and the bell will rise or fall, increasing or decreasing the gas-way of the valve according to the varying demands on the district. If, however, 30-10ths pressure be now required, the weight of the bell must be increased, either by placing weights directly upon it, or by removing weights from the counterbalance-rod. Upon the additional weight being put on, the bell will commence to fall, and with it the valve; thus augmenting the flow of gas and the outlet pressure. This will continue until the latter is sufficiently increased to enable it to again uphold the governor-bell. When this is so, the bell is once more in equilibrium; and it will continue to maintain a steady pressure until the load is again altered. If it be desired to reduce the pressure, the weights on the holder should be gradually removed; and the bell will commence to rise, and continue so to do until, by partially closing the governing valve, it has reduced the outlet pressure to the desired point.

It has been pointed out (as in the paper especially referred to below) that the necessity for this alteration of the load of the governor is due almost solely to the inadequacy of the capacity of the district mains; and that, if the whole of these were large enough to convey the maximum quantity of gas required to every part of the district at a pressure which would suffice for the minimum demand, no change of load would be necessary, and the valve would open and close freely and unaided, according to the demand. But this is practically never the case; and hence it is necessary to augment, by loading, the weight of the bell and the density of the gas in the mains, and *vice versâ*.

In a governor constructed simply as just described, the base of the valve presents to the flow of inlet gas an opposing surface of considerable area, the effect of which, if not compensated for, would seriously derange the working of the governor, and prove, in fact, a source of considerable danger of collapse of the governor and of explosion. For this reason, it was usual, in days gone by, to make the diameter of the bell very large in proportion to that of the valve, in order to minimize the disturbing influence of the inlet pressure on the base of the valve. Very great improvements in this respect have, however, been introduced of late by Messrs. W. and B. Cowan, Messrs. J. and J. Braddock, and other firms, by the use of a compensating chamber—above the bell in Messrs. Cowan's governor, and within it in Braddock's—which is supplied with gas from the inlet main, and is exactly equal in area to that of the base of the valve. When, therefore, any alteration of the inlet pressure is exerted on the valve base, thus tending to derange the working of the bell (which should be actuated solely by the outlet pressure), the same influence is exerted over a similar area in the compensating chamber, tending to operate the valve in the opposite direction, and it is thus, with the bell, maintained in perfect equilibrium. The operation of this chamber is therefore to balance the influence of the inlet pressure on the valve base by an exactly equivalent force above the valve, and so enable the governor undisturbed to satisfactorily perform its functions.

In the governors of the two firms named, the connecting mains and valve chamber are distinct from the bell and tank; the gas being conveyed to the bell and compensating chamber by tubes of small diameter—thus minimizing greatly such an escape of gas, with its attendant dangers, as might be caused by any accident to the governor bell. In Cowan's governor, the valve is suspended from the bell by a tube rod, which also serves the purpose of conveying inlet gas to the compensation chamber; while concentric with this tube is another of larger diameter, conveying gas from the outlet of the valve chamber to within the governor bell. The valve is of the slotted cylindrical type. In Braddock's governor, the gas enters from above the valve chamber; the valve is parabolic; and the inlet and outlet pressure tubes are distinct from each other. The former passes from the valve chamber under the centre of the bell into the compensating chamber; and within it is contained the rod by which the valve is suspended. The last-named firm have lately introduced a governor constructed on lines differing materially from the foregoing. A description of this governor appeared in the JOURNAL for Oct. 6, 1891.

There are three methods of loading and unloading the governors—*i.e.*, by the addition or removal of small metal weights on the bell direct or on the counterbalance, and by means of water, which is admitted to, or extracted from, a tank placed upon the governor bell. The last-named has many advantages over the use of metal weights, not the least of which is the the quiet and gradual manner in which the change of

pressure is effected, which contrasts very favourably with the sudden jerks given to the governor by the unceremonious and unskilful operations of the average attendant.

An exceedingly interesting and instructive article on the "Automatic Maintenance of Constant District Pressures," from the pen of Mr. William Cowan, appeared in the JOURNAL for May 16 last (p. 886). This should have the closest attention of the student.

The question of automatically loading and unloading station governors in accordance with the required alterations of pressure hour by hour, has also been carefully studied by Mr. Cowan, an early result of which was his well-known "Automatic Pressure Changer." In the article just referred to, however, a new method of regulating the district pressures (and in the writer's opinion, a very promising one) is discussed. In the same issue of the JOURNAL is published an abstract specification of Messrs. Hawkyard and Braddock's method of automatically regulating the pressures in accordance with the demand on the district. The student should also read this abstract.

In regard to the statement made at the close of last week's chapter, we learn that copies of the late Mr. Hartley's *brochure* entitled "Ammonia Liquor Tests," are still to be had.—ED. J.G.L.

TECHNICAL RECORD.

CARBON DEPOSITS ON GAS-BURNERS.

In the last number of the *Journal of the Society of Chemical Industry*, there was a communication on the above subject from Dr. E. G. LOVE, the Gas Examiner for New York City. As this matter has been several times referred to in our pages,* we reproduce the article, with the illustrations, as an interesting supplement to what has already appeared.

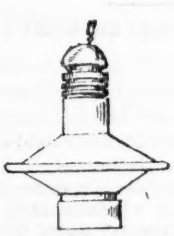
The formation of hard, carbonaceous deposits in the slits of steatite flat-flame burners is one of the annoyances which many gas engineers in the United States have encountered.

The difficulty first shows itself in the ragged outline of the flame. This increases, more or less rapidly, until the flame is very much forked; and ultimately the slit is practically closed. The holes of the fishtail burner appear to offer less favourable conditions for this deposit than the slits of the different types of batswing burners.

The remedy commonly applied is to cut out the deposit with a fine saw or steel ribbon. But this is never satisfactory; for, even if the slit itself is well cleared, the inner chamber of the burner tip usually retains so much of the deposit as to interfere with the proper flow of the gas. The deposit is very hard; and if it exists in any considerable quantity, the chances are that the tip will be broken in the effort to clean it. This difficulty is so serious in some places as to necessitate the substitution of a metal tip in place of the steatite; the former, so far as I know, not being subject to these deposits.

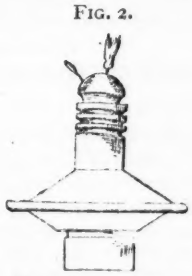
The most interesting fact connected with these deposits is that sometimes they are not confined to the burner slit, but grow up into the flame on the outside of the burner itself. These growths are most commonly found on burners consuming carburetted water gas, though occasionally they occur when coal gas of high candle power is used, especially if naphtha is employed as an enricher.

FIG. 1.



December 5th, 1891.

FIG. 2.

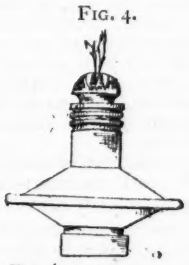


December 7th, 1891.

FIG. 3.

December 10th, 1891.
Front.

FIG. 4.



December 10th, 1891.
Side.

* See Vol. XXXIX., p. 65; and Vol. XLIX., pp. 988, 990.

FIG. 5.

December 19th, 1891.

FIG. 6.

December 21st, 1891.

FIG. 7.

December 23rd, 1891.
Front.

FIG. 8.

December 23rd, 1891.
Side.

The growth first appears as a fine black splinter attached to the edge of the slit; but, as it grows, it spreads out into some curious shape, increasing in size until the weight becomes too great for the delicate pedicel, and it falls off, or from some change in the conditions it gradually wastes away. Occasionally it grows up in a single night; but usually it is several days in forming. The average height of these growths is perhaps about ¼ inch; and the weight, from 0·5 to 1 grain. Several years ago, I raised one which was nearly an inch high, and weighed 2·6 grains; but it is very seldom they grow to this size.

Up to the present time, I have not been able to find any satisfactory explanation for the formation of these curious growths; but I am hoping that a line of experiments which I am following out will throw some light upon the matter. The immediate cause of the deposit is the dissociation of hydrocarbons at the high temperature attained in the steatite tip, and is doubtless similar to the deposition of carbon in the retorts used for "fixing" the naphtha vapours. This, however, does not explain the conditions necessary to the formation. They are not, as might be supposed, the most common in those gases having the highest candle power and containing the largest quantity of hydrocarbon vapour. Neither can they be depended upon in a gas which has shown a tendency to produce them. They may grow, one after another, for a month, and suddenly the deposits will stop, and not reappear for several months, or even years. Some ten years ago, one of the gases in New York City produced some very large deposits for about a month; but since that there has not been a trace of any.

These growths are composed practically of pure carbon; they are entirely consumed on ignition, and are free from iron, which would certainly not be the case if iron carbonyl had a part in their formation.

The accompanying diagrams show the general character of these growths. Each group of four represents a single deposit photographed at different stages of its growth; and in both cases the deposits dropped off soon after the photographs were taken. In general, they were of a dull black colour; but small portions of each had a bright metallic lustre, much resembling silver, and when examined microscopically showed a beautifully concretionary structure.

ON THE COMPOSITION OF SMOKE.

Abstract of a Paper contributed by M. P. Laktine to the "Annales de la Societe Technique Russe."

Every attempt that has been made to suppress smoke or to diminish its quantity has failed, because the elements of this substance have not yet been sufficiently studied. Its gaseous portion has been constantly subjected to analysis, while the solid and liquid constituents remain little known. At the same time, it is to these that smoke owes its reputation and quality of a noxious product, especially in the estimation of dwellers in large towns. According to the author, the powerlessness of struggles against the effects of smoke is due to the fact of its composition being imperfectly determined. This opinion is supported throughout the article, of which the following are the most important parts.

When combustion is effected with materials containing proportionally more hydrogen—for example, coal, turf, lignite, wood, &c.—light products of combustion are disengaged under the influence of high temperature, and notably those which contain hydrogen and carbon. Their liberation is either complete or partial, so that the solid carburets which contain less hydrogen and carbon, and which are in a state of incomplete combustion, are carried away by the light products. Then the

carbonic acid, the nitrogen, and the rest of the oxygen combine not only with the carbonic oxide, but also with the mass of unburnt bodies and compounds of carbon, hydrogen, oxygen, and a little nitrogen. At the same time, pure carbon in a state of fine powder (soot) is thrown off. All these substances form a mass of grey, yellowish grey, or dark grey colour, which is called smoke. Herr F. Fischer has completed this definition in the following statement: "If combustion is effected with little oxygen, the smoke will contain soot more or less pure; if the temperature is not too high, there will be disengaged with the smoke a portion of permanent and slightly-burnt gas. Consequently, smoke is composed of different elements, tar and lamp-black, and rarely of soot alone." These hypotheses have been deduced without precise preliminary researches into the composition of smoke. Consequently, an inexact notion respecting the latter has been conceived, because the ash that exists in all smoke, the sulphurous and sulphuric acids (due to the coal), and the aqueous vapour have not been taken into consideration.

In order to scrupulously analyze the solid elements of smoke, the author takes the deposit at the inlet to the chimney. The fires which gave him his samples were regularly attended, and controlled by the quantity of water evaporated. The flues were fitted with economizers 10 metres long, which caused the soot taken for analysis to be such as had travelled for a considerable distance, and had dropped its heavy portions. The temperature of the spot whence the soot was taken was so low that no combustion was possible. It is likely that the smoke at the outlet of the chimney is different from that at its base; in any case, the difference is quantitative and not qualitative. This opinion is otherwise confirmed by the determination of the quantity of the solid elements of the smoke taken on leaving the chimney.

The figures of the following analyses were obtained from samples secured after long heating during two or three months, and in thick layers, in order that they might exhibit an exact average of the soot deposited at the chimney inlet. Their homogeneity appeared to be perfect. First, in the case of wood fuel, the soot of which is described as a light, downy powder of a blackish colour, and giving a strong alkaline reaction. Its composition, after desiccation, was as follows:—

Water	1·20
Matters soluble in water and hydrochloric acid	65·35
Carbonized matter	28·35
Insoluble ash	5·10

The soluble constituents (65·35) were composed of—

SiO_2	1·50	Al_2O_3	1·59
SO_3	11·00	FeO	0·54
P_2O_5	2·88	K_2O	15·80
CNH	0·50	Na_2O	1·12
CaO	20·90	CO_2, H_2S, and organic soluble matters	6·37
MgO	3·15		

It should be remarked that this soot, like all the other samples, gave no light products of distillation. It burns with difficulty. A gramme of it calcined in an open platinum crucible for three hours left 0·60 gramme of residuum, and was still black.

With turf, the soot is a powder soft to the touch and of a deep brown colour, with strong alkaline reaction. It presents the following composition:—

Water	2·82
Matters soluble in water and hydrochloric acid	26·39
Carbonized matter	44·38
Insoluble ash	26·41

The soluble matters were composed of—

SiO_3	2·10	Al_2O_3 and FeO	4·66
SO_3	4·46	$K_2O(Na_2O)$ traces	2·52
P_2O_5	1·38	H_2S, CO_2, and organic matters	5·33
CaO	5·17		
MgO	0·77		

Half a gramme of this soot took 10 minutes' calcination in a platinum crucible; and 47·47 per cent. of residuum gave 43·2 per cent. of dry ashes.

Castor-oil cake was burnt in the same way; giving a soft soot of deep black colour, and very strong alkaline reaction. Its composition was as follows:—

Water	1·73
Matters soluble in water and hydrochloric acid	65·87
Carbonized matters	11·90
Insoluble ash	20·50

It is hardly necessary to give the detailed composition of this somewhat exceptional fuel. The soot is difficult to burn.

Naphtha residuum gave a fine soot, of strongly acid reaction. The following was its composition:—

Water	1·55
Matters soluble in water and hydrochloric acid	26·05
Carbonized matters	61·25
Insoluble ash	11·15

The soluble matters (26·05 per cent.) were composed of—

SiO_3	1·05	CaO	5·10
SO_3	10·33	MgO	1·08
P_2O_5	traces	K_2O	4·18
Al_2O_3 and FeO	4·15	Na_2O	traces

This soot burns with great difficulty. Half a gramme took 20 minutes' calcination to completely burn. The quantity of ashes diminished from 37·20 to 31·20 per cent. The author supposes that during this calcination a portion of the cinder was volatilized with the burnt matters. Neither the ash nor the soot of this fuel contained chlorine. The soot had in it all the components of vegetation—K_2O, P_2O_5, &c.

These experiments indicate, in the combustion of different kinds of fuel, the presence of soot allied with a notable quantity of easily soluble alkaline or acid ash. The presence of the soot is explained better by the difficulty of burning it than by incomplete combustion in the furnace. It will not burn, even in presence of oxygen at a high temperature, because the period of its passage through the place where it is exposed to heat (*comburé*) is too short. And if it were burnt, the smoke would change its colour, since in place of soot it would contain ashes in a state of very fine powder. Consequently, the appearance of smoke in regular firing may be explained by the volatility of the components of the ash, disengaged with the products of combustion; as, for example, K_2O, SO_3, P_2O_5. The distilled products can be partly burnt during their passage, because the ash forms a kind of envelope for the carburetted elements, and protects them from the oxygen. The ash may be well represented as a nucleus round which are disposed the unburnt volatile portions.

We know that a rapid evolution of smoke takes place when a fresh quantity of combustible is introduced into a furnace. This phenomenon is explained by the choking of the air passages through the fire, which results in the cooling down of the heated space. The author does not know if this way of looking at the matter is based on exact determinations of the temperature of the fire, or even on analysis of the gases in the flues; in any case, it does not apply to all kinds of fuel, such as naphtha or wood. Sometimes the fresh bed of fuel checks the draught; passing the air through a number of smaller orifices with heightened velocity. Everything that relates to the cooling of the furnace, its value and influence, is problematical. From the beginning of the firing up, when all around the furnace is cold, the same quantity of smoke as usual is produced, if the liberation of the vapours cannot be enlivened by an energetic action. It is more simple to explain the formation of smoke at this period by the simultaneous disengagement of humidity, ashes, and the gaseous products of distillation. The vapours, driving away the air, prevent the combustion of these products, while the ashes increase this effect. If we have to do with dry fuels, the components of the ash play a more important part (the sulphur in the case of coal, sulphur and potash in the case of castor-oil cake).

To confirm his conclusions respecting the composition of smoke, drawn from his analyses, the author gives a determination of the quantity of ash escaping by the chimney. In order to arrive at this, it was necessary to ascertain the quantity of ash originally present in the fuel, which in this case was castor-oil cake. The experiment was difficult, because in any process of calcination a portion of the ash volatilizes along with the carbonaceous products. The difficulty was finally overcome by mixing the fuel with an equal weight of pure and dry precipitated silica. The mixture is then carbonized, and washed with boiling water. The solution is evaporated in a platinum capsule, and the residuum calcined until all the organic matters are burnt off. This weight is added to that of the ash obtained from the combustion of the coke. According to the author, in the ordinary way of combustion the resultant ash is from 15 to 20 per cent. below the true quantity; the difference represents the proportion that escapes by the chimney.

Hence it results from these laborious experiments and exact analyses that, as the author says: (1) The formation of smoke is unavoidable, even with the most perfect heating, in the case of fuels containing both ash and water; (2) the suppression of smoke by means of complete combustion is impossible; (3) a small proportion of fuel is always lost by volatilizing with the smoke and combining with the ash; (4) the ordinary process of analyzing ashes by means of direct calcination is inexact, and should be replaced by another method.

THE TRANSFORMATION OF HEAT INTO CHEMICAL ENERGY.

A recent number of the *Berichte der Deutschen Chemischen Gesellschaft* contained an article by Herr A. NAUMANN on "The Transformation of Heat into Permanent Chemical Energy in the Production of Water Producer Gas and Carbonic Acid Producer Gas," of which the following is a translation:—

Three methods are chiefly available for the transformation of coal into heating gas: The production of illuminating gas by the destructive distillation of coal; that of water gas by the action of steam or the elements of water on heated fuel; and that of producer gas, or carbonic oxide, from coal supplied with air. In the production of illuminating gas, only a small fraction of the heat-energy of the coal is transformed into gaseous fuel. The relatively high price of this gas prevents its application on a large scale as a heating gas; but on a small scale it is employed for heating purposes and motive power in the absence of a cheaper gaseous fuel, and because it can be obtained in all large towns.

The formation of water gas is endothermic; heat is absorbed according to the thermo-chemical equation—

$$H_2O \text{ (liquid)} + C = H_2 + CO. \quad -38{,}770 \text{ calories}$$

The somewhat complicated apparatus required for the production of water gas only allows of its preparation with advantage on a large scale; but in that case the advantage is so considerable that, in the towns of North America, water gas has been substituted to a great extent, and sometimes altogether,

for illuminating gas for lighting purposes—its lighting power being obtained by so-called carburetting.

The production of producer gas is comparatively simple and easily carried out. The formation of this gas is exothermic; it liberates heat

$$\underbrace{C + O + 53{\cdot}6 \text{ parts by weight of nitrogen}}_{\text{air}} = \underbrace{CO + 53{\cdot}6 \text{ parts by weight of nitrogen}}_{\text{producer gas.}} \quad . \quad + 29{,}690 \text{ calories}$$

The amount of heat here indicated causes the theoretical temperature of producer gas at the moment of its formation to be 1446° C., assuming that the specific heats of its constituents are the same at high as at ordinary temperatures. The heat of formation (29,690 calories) thus indicated is utilized if the gas be consumed on the spot as fast as it is produced, but is lost if the gas is conveyed to any distance, or stored and allowed to cool to the ordinary temperature of the air (15° C.); the amount of heat then available being only that evolved by the combustion of the carbonic oxide in the gas—that is, 67,960 calories. Out of a total of 97,650 calories available, only 67,960 would be utilized in the latter case; corresponding to a waste of 30·4 per cent. of the theoretical quantity of heat available.

Two methods are within our reach for converting into permanent chemical energy the quantity of heat appearing in the form of high temperature in the producer, and incorporating it in the gas. Either so much water may be introduced into the producer with the air as to absorb from the heat generated (+ 29,690 calories) by being decomposed in contact with the fuel, thereby producing hydrogen and carbonic oxide, which mix with the ordinary producer gas generated at the same time, enriching it and forming a heating gas, which may be called water producer gas; or carbonic acid may be similarly introduced into the gas-producer to form carbonic oxide, which mixes with the ordinary producer gas generated at the same time, forming a heating gas, which may be called carbonic acid producer gas.

In the following tables for each of these two heating gases, the composition, heat of combustion, rise of temperature of the flame, and heat given up by the products of combustion for a reduction of 1° in temperature are compared with the corresponding amounts for producer gas. I may here mention that the method of procedure for determining these values is tedious and troublesome; and I therefore limit myself to tabulating the results. The composition of water producer gas from fluid water at 15° C., and gaseous water at 15° C., is calculated from the following thermo-chemical equations II. and III., and that of carbonic acid and producer gas, from equations I. and IV.:—

	Calories.
I.—$\underbrace{C + O + 63{\cdot}6 \text{ parts by weight of nitrogen}}_{\text{air}} = \underbrace{CO + 53{\cdot}6 \text{ parts by weight of nitrogen}}_{\text{producer gas}}$	+ 29,690
II.—H_2O (liquid) + $C = \underbrace{H_2 + CO}_{\text{water gas}}$	− 38,770
III.—H_2O (at 15° C. gaseous) + $C = \underbrace{H_2 + CO}_{\text{water gas}}$	− 27,970
IV.—$CO_2 + C = 2CO$	− 38,270

In the following tables are given separately—first, the volumes of the gases formed and mixed in the producer, and of the water gas, which together form water producer gas; and, secondly, the volumes of the chemical constituents of those gases. For carbonic acid producer gas, the volumes of the producer gas and the carbonic oxide formed by the reduction of the carbonic acid introduced into the producer, are first given, and afterwards the volumes of the chemical constituents of these gases.

I.—Composition of producer gas from pure carbon—

Carbonic oxide	34·3 per cent. by volume.
Nitrogen	65·7 „ „
	100·0

II.—Composition of water producer gas—

		Percentage by Volume. From Liquid H_2O at 15°.	From Gaseous H_2O at 15°.
1.	Producer gas	65·55 ..	57·9
	Water gas	34·45 ..	42·1
		100·00 ..	100·0
	Equivalent to—		
2.	Hydrogen	17·20 ..	21·1
	Carbonic oxide . . .	39·70 ..	40·9
	Nitrogen	43·10 ..	38·0
		100·00 ..	100·0

III.—Composition of carbonic acid producer gas—

1.	Producer gas	65·3 per cent. by volume.
	Carbonic oxide made from carbonic acid and carbon	34·7 „ „
		100·0
	Equivalent to—	
2.	Carbonic oxide . . .	57·1 per cent. by volume.
	Nitrogen	42·9 „ „
		100·0

A glance at the preceding volume percentage composition of the three heating gases shows at once the superiority of water producer gas and of carbonic acid producer gas over ordinary producer gas. This superiority is shown still more clearly by a comparison of the following values: (1) The heat of combustion of a litre of each gas calculated from the above composition, and the known heat of combustion of their constituents. (2) The rise of temperature of the flame calculated from the temperature of combustion and specific heat, and the quantity of gases existing after combustion. (3) The heat given off by the products of combustion of a litre of gas by the reduction of the temperature 1°. For comparison, these values are also calculated and given for water gas, it being assumed that combustion in all cases is effected with only the quantity of air theoretically necessary:—

		(1) Calories.	(2) Degrees.	(3) Calories.
1.	Producer gas	1044 ..	1904 ..	0·5487
2.	Carbonic acid producer gas . .	1739 ..	2449 ..	0·7101
3.	Water producer gas, from liquid water at 15° C.	1652 ..	2356 ..	0·7016
4.	Water producer gas, from gaseous water at 15° C.	1790 ..	2431 ..	0·7363
5.	Water gas	2812 ..	2830 ..	0·9934

The above changes of sensible heat into permanent chemical energy which have been theoretically and experimentally determined have also been applied in practice.

The so-called Dowson gas is technically water producer gas. Such a gas has, according to Dowson's own data, the composition shown by the figures in the first column; another, according to a paper by Schilling, has the composition shown in the second column:—

Constituents.	In Volumes.	Per Cent.
Hydrogen	18·73 ..	17
Carbonic oxide	25·07 ..	23
Methane	0·31 ..	2
Ethylene	0·31 ..	—
Carbonic acid	6·57 ..	6
Nitrogen	48·98 ..	54
Oxygen.	0·03 ..	—
	100·00	100·0

The discrepancies in the composition of theoretical water gas and of that used in practice are explained by the consideration that the latter contains carbonic acid, which, if completely reduced, would give double its volume of carbonic oxide, and that pure carbon is assumed to be used in the formation of theoretical water producer gas in the above calculations.

In Dowson's arrangement, the excess heat of production of the producer gas is actually transformed into the chemical energy of water gas produced by the simultaneous introduction of air and steam into the producer, and their decomposition by the coal, which, being added to the producer gas, forms water producer gas. In the new form of Siemens furnace, the same *modus operandi* is partially carried out. Steam is also blown into the producer; and besides this a portion of the products of combustion is led into the producer at a high temperature. As these products contain steam as well as carbonic acid, both water gas and also carbonic acid producer gas are formed. The sensible heat is here converted into chemical energy by the conversion of steam into water gas ($H_2O + C = H_2 + CO$) and the carbonic acid into carbonic oxide ($CO_2 + C = 2CO$); the result being an increase of the hydrogen and carbonic oxide in the gas made. To produce water gas from steam and hot carbon without any extraneous heat, the steam would have to be introduced at the temperature of 3230°. To produce carbonic oxide from carbonic acid and heated carbon without any extraneous heat, the carbonic acid would have to be introduced at a temperature of 4008°. However, the nitrogen contained in the hot products of combustion carries with it a considerable amount of heat, which is available for the above-named processes of conversion. But the introduction of relatively large volumes of nitrogen, contained in the products of combustion, into the gas-producer, and this going into the heating gas produced, prevents the total utilization of the products of combustion in this manner. Therefore in the new form of Siemens furnace not more than half the products of combustion are returned to the producer. The theoretical limit of this amount depends upon the temperature of the returned products of combustion, also on their composition, as per table below; assuming that only the theoretical quantity of air required for perfect combustion is used and taken with reference to the calorific and other values given above for 1 litre of producer gas, water producer gas, carbonic acid producer gas, and (for comparison) also water gas.

Weights of Products of Combustion in Grammes in One Litre of Theoretical Heating Gas.

Heating Gas.	Products of Combustion. CO_2. Grammes.	N. Grammes.	H_2O. Grammes.
1. Producer gas	0·6762 ..	1·6474 ..	—
2. Water producer gas from gaseous water at 15° C. .	0·806 ..	1·965 ..	0·171
3. Carbonic acid producer gas .	1·125 ..	1·909 ..	—
4. Water gas	1·064 ..	3·207 ..	0·504

According to scientific observation, these are the highest results which can be attained theoretically for converting sensible heat into chemical energy for water producer gas and carbonic acid producer gas.

WATER-METERS FOR MUNICIPAL PURPOSES.

At the Meeting of the Eastern Counties Branch of the Incorporated Association of Municipal and County Engineers at Bury St. Edmunds on the 10th inst., a paper on the above subject was read by Mr. B. GODFREY, of Droitwich.

The author began by remarking that the water-meters at present in the market may be divided into three classes—The inferential, the rotary piston, and the absolute. The inferential, as its name implies, only "infers" the quantity passed through it, and is far from a measure of capacity. It is expensive to keep in order, though in first cost it appears to be the cheapest meter in the market; and this is the only reason that can be given for its adoption in various towns. Upon looking into the cost, however, as compared with other meters, it appears that, taking a 1-inch meter as the standard, the quantity delivered at an effective head of 150 feet per hour is 2500 gallons. With another representative type of meter of the rotary piston class, the quantity passed is 3000 gallons; while with ⅝-inch meters of the same classes, the hourly quantity is 500 and 1800 gallons respectively—thus showing that, although the inferential only appears to be about two-thirds of the cost of the rotary piston meter, it is in reality quite as high in price for the effective work done. The author's experience of meters of the inferential class is very unsatisfactory; and he is not replacing any of them as they stop.

The rotary piston meter is the one most used at present; two representative types being Kent's and the London Meter Company's. In this class the water is measured in a chamber, which expands and contracts alternately, but with a circular motion, so that there is no concussion. In Kent's meter, the piston is of vulcanite, working in a very accurately made chamber of Delta metal, fitting loosely into a cast-iron case, from which it is easily removed for exchange, examination, or cleaning, without uncoupling the body of the meter. In action, the water enters under the moveable chamber of the meter, and passes through a large strainer, which very effectually removes grit from the water. The London Meter Company's meter consists of a gun-metal chamber, containing a vertical hub, with four vanes (made of vulcanite) set at each end of two circular spindles diametrically opposite to one another. The spindles, revolving horizontally through the hub, alternately stand on end, and form a measuring chamber in the shape of a quadrant of a circle, or lie flat to empty opposite the port holes. In both these meters, the working parts being made of a very light material, running in water, will work with a minimum of friction, and are suitable for high velocities; but they should not be used on old mains, or near dead ends, where the water is liable to contain iron oxide or grit, as a very slight furring in the working chamber is likely to cause them to stop entirely, owing to the accuracy with which they have to be made.

Absolute or packed reciprocating meters are well known. They may be subdivided into two classes—the single-cylinder and the double-cylinder. The former is best represented by a well-known meter of high repute, and consists of a cylinder having its passages in connection with a four-way cock, which is controlled by a tumbling weight in connection with a rack worked by the piston-rod. By this means the inlet and outlet are alternately placed in connection with opposite ends of the cylinder at the completion of each stroke. In all single-cylinder meters, the valve movement is actuated by auxiliary means. Some meters of this class simply record the number of strokes made, whether long or short; thereby causing the registration to be greater per quantity passed at a high speed than at a low. There are many two-cylinder meters in the market at the present time. In this class of meter, the movement is all made under water; the general principle being that each piston, at the end of its stroke, actuates the valves of the other. Considerable pressure is required to move some meters of this kind; but this is compensated for by the area of the piston upon which the water acts. Meters of this class run fairly well in a hard water, or one carrying with it slight deposits, as each stroke of the piston scours the interior of the cylinder; but if left for several days without use, they are rather apt to "stick up," owing to the piston adhering to the cylinder walls. Cylinder meters working at a high speed are liable to cause concussion.

The Kennedy meter possesses a great advantage in being constructed so that it can be fitted with a clock working a cylinder carrying a narrow strip of paper, upon which the piston of the meter moves a pencil, causing a succession of lines, varying according to the rate of flow from vertical, when much water is passing, to horizontal, when no water is being used. This will be found very useful for station meters, as it shows any unusual demand on the supply. The quantity represented by each vertical line being known according to the size of the meter, the number of lines per hour can be counted, and the quantity per hour ascertained. Of course, this is in addition to the ordinary dial.

Another type of cylinder meter is the Schönheyder, in which three loose gun-metal cylinders are contained in an outer case, with three pistons radiating from one centre, which works on a flat plate affixed to the bottom of the case. The centre and plate form a valve, with three ports for the admission of the water to the cylinder, and one large outlet-port. The water is admitted alternately to the cylinders through these ports. At the same time that one cylinder is filling, another is over the outlet-port and discharging the water, which causes a semi-rotary movement to the pistons, thereby driving the counter-gear. There is a considerable concussion to this meter when running at high speeds; and it is very bulky as compared with two-cylinder meters. Owing to the cast iron forming the interior having no protection, the first water passed after the meter has stood for a night or so is very dirty and unfit for use. In the author's experience, the first cost of this meter is high, and the attention required afterwards very considerable. When running fast, with a high back-pressure, the meter is liable to short-stroke; thereby causing over registration.

The author next noticed the Deacon waste-water meter, which is so well known as to scarcely need description. It consists of an iron case, containing a hollow truncated cone, in which works a disc balanced by a wire over a pulley, with a corresponding weight. When the meter is closed, the disc is at the top of the cone, and fits exactly; but, as the flow of water increases, the disc is depressed according to the volume passing. Attached to the wire over the pulley is a carriage holding a metal pencil, which makes a series of lines on a specially ruled diagram, on a drum worked by a clock. So sensitive is the action of the disc, that a change in the rate of flow as small as 50 gallons per hour is immediately recorded on the diagram. At night when the proper consumption has ceased, the waste through defective fittings or mains is, of course, constant; and the pencil draws a horizontal line on the diagram, frequently uninterrupted for some hours. By dividing the town into districts, and closing the main valves at intervals, the diagram will point out the change in the rate of flow at the time corresponding to the closing of each valve, after which the inspector, being guided as to those streets in which the waste is taking place, is able to visit and "sound" each stopcock during the night, and next day visit those premises upon which water was being used. This system saves the occupiers of property the annoyance of frequent calls from the inspector, as he only visits those into which water was passing during the night.

This concluded the author's description of meters which have come under his supervision. He then directed attention to the necessity for selecting a meter suitable for the purpose for which it is intended. He said it was impossible to choose one particular meter, and use it as a standard pattern to be rigidly adhered to in any town or district, as at present there is no meter suitable for trade and domestic purposes alike—the demand for water being under such varying conditions. For domestic purposes, a reciprocating piston meter is the most suitable, as the water is frequently taken at a very slow rate. For trade purposes, such as supplying boilers, hotels, innkeepers, &c., the water is taken intermittently at a much higher rate of flow, such as would cause concussion in a reciprocating piston meter, unless of a large size. It is therefore best to use a meter of the rotary piston class, which will permit of the flow of water at high speeds, and also register with comparative accuracy a small flow, which is sometimes required on the same premises. A boiler should never be permitted to be supplied direct from the service, no matter how high the pressure on the main may be, as there is always a risk of the pressure being taken off, when the hot water from the boiler may be forced back into the meter, and injure the working parts, especially when they consist of vulcanite. For road-watering purposes or swimming baths, the inferential meter may be used, as they are then working under the most favourable conditions—the water being all passed at full bore without back pressure; while their small size enables them to be fixed under the footpaths, or in the base of a stand-post. The supply to urinals is the reverse of the one first considered, as the supply is taken very slowly during the 24 hours; and in this case the reciprocating piston meters should be used. For hydraulic lifts the rotary piston meter is the most suitable, and should be of the full size of the main. Rotary piston meters of this class can be had tested up to 25,000 lbs. pressure if necessary. For water-works station meters, the rotary piston meter is suitable, as also the Kennedy meter, which, when fitted with a clock and diagram, is especially serviceable; but in this case care should be taken that the meter is sufficiently large for its work to prevent concussion. The author has at present in use, at the Droitwich Water-Works, a Kennedy meter which has supplied the whole town for 14 years, and has not cost more than £5 for repairs during that time—being still in perfect working order.

Before putting to work a new meter, or one that has been repaired, it is advisable to give it a short run, both at high and low velocities, in the testing-shop of the water-works; or, if there is no testing-room, to connect it to a service-pipe, and ascertain that it registers when passing water. It has never been found to answer to couple up about half-a-dozen meters, and pass water through them as a test, as there will be a considerable discrepancy in the registration. A 100-gallon tank with a gauge glass will be found sufficient for testing most meters (the gallons being marked on the glass with a file), and can be made cheaply. A long tank will be found the most accurate; and it should be fitted with a large cock to allow of being emptied quickly.

The author is strongly of opinion that, if meters were more generally adopted for town supplies, the consumption of water would be considerably reduced, and a much fairer system of payment would be the result, as the water would be paid for by

the persons using it. It may be said, on the other hand, that it would tend to prevent poor persons using the quantity necessary for cleanliness. But this is easily overcome by fixing a minimum charge on each meter, sufficient to admit of what is necessary for sanitary purposes being employed. Householders would be careful of their water-fittings, and see that they were not left to become defective, or the water allowed to run to waste, as at present is too frequently the case until the house is visited by the water inspector.

Accompanying the paper was a table prepared by the author, showing some particulars as to the water-meters in use in various towns. Those which have adopted the meter system are able to report a decrease in the consumption of water; and those which at present have an intermittent supply might, by employing them, be able to have a continuous one, and thus save the cost of extensions of wells, machinery, &c.

REGISTER OF PATENTS.

Water-Meters.—Thompson, W. P.; communicated from L. Valentine, of Frankfort-on-the-Maine, Germany. No. 13,228; July 19, 1892.

This invention relates to a water-meter, which is free from the disadvantage of certain other meters—that "their axes and bearings very quickly wear out, owing to the great speed at which the winged wheels revolve." The meter has this further advantage—that "only a small quantity of water is requisite in order to set the winged wheels in motion; and consequently even small quantities of water will not escape being measured."

The meter consists of a casing, divided by diaphragms into three chambers. The first chamber contains the winged wheel; while chambers Nos. 2 and 3 are in communication by an opening closed with a valve. The latter is kept constantly closed by means of its own weight; but it can be lifted by the inflowing water, when the pressure is such that it overcomes the weight of the valve. The valve-weight can be regulated, and is provided with screws, which can be decreased or increased in number according to requirements. In this manner, small quantities of water are compelled to take their way through an opening in chamber No. 1, thereby setting the winged wheel in motion, since they cannot raise the valve. Large quantities of water take a duplex course—that is to say, on the one hand they raise the valve, while on the other they flow through the inlet openings on to the winged wheel. This latter is provided on its upper front side with a disc, having a concentric cut-away portion. The disc bears two winged pieces; and the corresponding part of the chamber wall above has a further opening, the size of which can be regulated by means of an adjustable disc. At the usual pressure, the water runs through the different openings into chamber No. 1, where it works in a checking manner upon the winged pieces. The disc provided with the concentric opening will consequently prevent the inflowing water from producing a disturbing effect on the winged wheel; and consequently the number of its turns is lessened, and the objection already mentioned is avoided. The checking influence of the inflowing water can be regulated, by the slide in the chamber wall being adjusted to a suitable extent; while exits are provided for the water to leave chamber No. 1.

Gas-Engines.—Oechelhäuser, W. von, and Junkers, H., of Dessau, Germany. No. 14,317; Aug. 8, 1892.

Gas-engines, as heretofore constructed for producing great power, say the patentees, are "of large size, the cost of manufacture is very high, and the working is rendered difficult by too great heating and frequent spontaneous ignitions. In addition to this, the consumption of gas does not decrease with the size to the extent which might have been expected." With their improved engine, designed chiefly for exerting great power, these defects are said to be obviated "by a high compression not heretofore obtained in the regular operation, a high working pressure, a complete removal of all the products of combustion, and an entire separation of the air for the cleansing from the charge of gas."

The engine cylinder has two pistons, of equal or different diameters, and the strokes which always move in opposite directions, and have the three-fold object of compressing the charge during their approach, communicating power to the driving-shaft during their separation after the explosion, and effecting, as distributing pistons, the discharge of the products of combustion and the admission of compressed air without the intervention of special valves. Suction of the charge by the engine-pistons does not take place, being effected by two pumps—one of which serves for compressing air, and the other for compressing gas. For removing the products of combustion, compressed air is supplied by the first pump; so that this air, on the termination of the expansion, when the two engine-pistons are farthest apart, passes through the entire working space and cleanses it. The fresh air remaining in the space is compressed by the two pistons as they approach each other again, and gas is injected into it at the proper moment. The air and gas pumps are arranged on the two sides of the engine-cylinder; and their pistons are connected with the two driving-rods of one of the engine-pistons.

Fig. 1 is a longitudinal section of such an engine, taken on the line *a b* of fig. 3, but showing the cranks in the diametrically opposite position to that shown in fig. 3. Fig. 2 is a longitudinal section on the line *c d* of fig. 3 (partly in elevation). Fig. 3 is a plan, partly in horizontal section. Fig. 4 is a transverse section on the line *e h* of fig. 3. Fig. 5 is a transverse section on the line *i m* of fig. 3.

A is the engine-cylinder; and B and C, the two plunger-pistons which work in the cylinder. The piston B is connected directly, by the rod B^1, with the central crank D of the driving-shaft; while two lateral cranks E of the shaft (arranged at an angle of about 180° to the central crank) are connected to the piston C by connecting-rods C^1, piston-rods F and H, and a cross-head I, so as to move the piston in the opposite direction to the piston B. The rod F is connected to the piston of the gas-pump G; and the rod H, with the piston of the air-pump L. The gas-pump is provided with lifting-valve gear; and the air-pump, with slide-valve gear. Fig. 3 shows the position of the two pistons, with the compressed charge between them, at the moment when the ignition takes place. During the operation, the two engine-pistons move apart in the direction of the arrows, and pass to the position shown in fig. 1, in which the piston B uncovers the air-admission orifice 1, and the piston C the discharge orifice 2. The compressed air will thus pass from a receptacle R supplied by the air-pump L, through the air-admission orifice 1, into the working space of the cylinder A, and expel all traces of the products of combustion through the discharge orifice 2—uncovered at the opposite end of the working space.

Fig. 1.

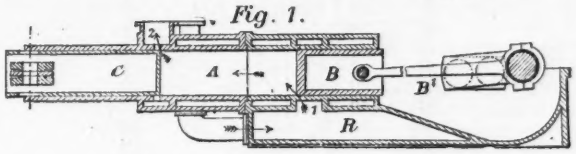


Fig. 2.

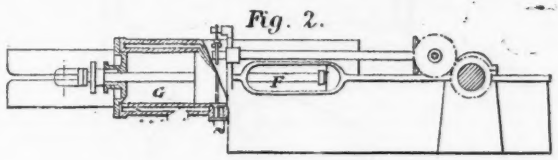


Fig. 3.

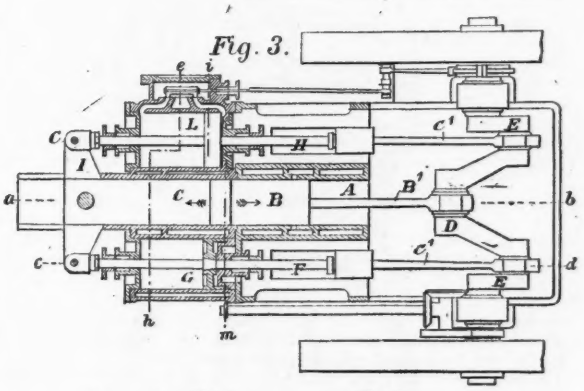


Fig 4

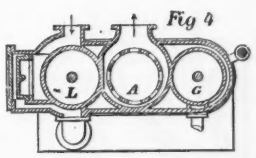
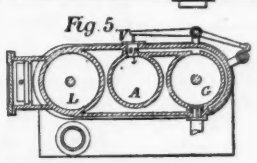


Fig 5



The thorough cleansing by the fresh air is due to the admission orifice at one end of the cylinder being opposite to the discharge orifice at the other end, and "to the suppression of all deleterious auxiliary spaces, which in other two-piston gas-engines are uncovered during the combustion between the two engine-pistons." Moreover, this thorough cleansing is accomplished in this engine "with a smaller expenditure of power than in the case of engines provided with a special air-admission valve," inasmuch as the piston B regulates the admission of the air, and uncovers in a shorter time a considerably greater sectional area of the admission orifice. The cleansing by air can thus take place rapidly at the dead point, and with little additional pressure of the compressed air, when the engine makes a great number of revolutions. The working space is quite filled with fresh air on the termination of the cleansing; so that the initial temperature of the compression is reduced as much as possible, and the occurrence of spontaneous ignition by the hot products of combustion is prevented.

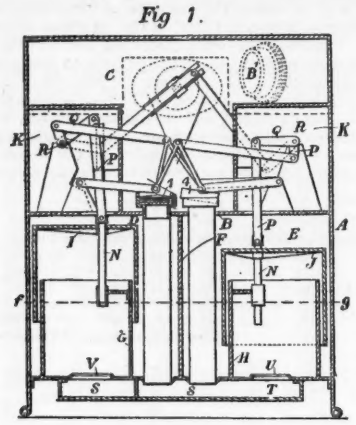
After the orifices 1 and 2 of the cylinder have been covered, the two pistons compress the air enclosed by them; and gas is at the proper moment forced at a higher pressure into this compressed air, by the gas-pump G, through the gas-admission valve V. As gas and air are thus forced into the engine cylinder through separate orifices and by separate pumps, at entirely different times, the cleansing (although all the products of combustion are expelled) does not give rise to any loss of gas, as in the case of the two-piston engines hitherto employed, where the gas and air are introduced simultaneously. The motion of the engine may be regulated, either by throttling the flow of gas to the pump G, or by acting upon the gas-admission valve V (fig. 5).

The engine (which can, of course, be operated by lighting gas, as well as by other combustible gases or petroleum) enables a pressure of combustion of 60 atmospheres and upwards to be produced, by reason of its arrangement and mode of action, which permits of a considerable reduction of the sectional area of the engine pistons and of the engine cylinder, and a great diminution of the cooling surfaces. Owing to the complete removal of the products of combustion and the high compression, high working pressure, and smaller cooling surfaces, a material saving of gas is said to be realized, as compared with the quantity of gas required in engines heretofore used.

Gas-Meters.—Johnson, J., communicated from F. E. Youngs, of Pittsburg, U.S.A. No. 19,202; Oct. 26, 1892.

This invention relates to valve mechanism especially adapted to be used in connection with meters; and its object is to provide for the control of direct-acting valves, so constructed and arranged that under no conditions can the valves leading to or from both sides of the pistons be open at the same time.

Fig 1.



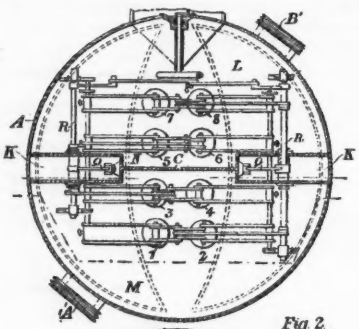
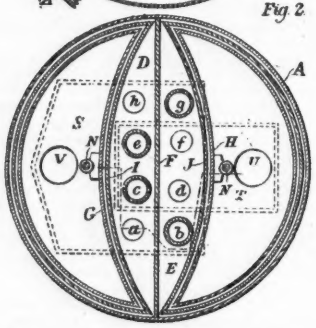


Fig 2.



A is a cylindrical chamber, divided by a horizontal partition B into an upper valve-chamber, and a lower cylinder-chamber—the latter being divided into two chambers D E by a vertical partition F. Placed within these chambers are the vibrating pans or pistons I J made of crescent shape (as shown in fig. 2), to allow room for ports between. The valve-chamber is divided into two chambers L M by the boxes K, and the vertical partition C, which extends from the top of the case to the horizontal partition B. Passing through the pans are piston-rods N, guided at their upper and lower ends, as shown. Connected at the lower ends to a cross-head placed on the piston-rods are the links P, which have their upper ends connected to the inner ends of arms Q, which extend inwardly from the rock-shafts R. These shafts are journaled upon supports, which extend upward from the partition B, as shown.

The chambers D and E are filled with liquor (preferably oil) to the level indicated by the dotted line *f g* in fig. 1: so that gas passing into the chambers forces down the pans I J. Secured to the under side of the bottom of the chambers is the passage S, serving to connect the lower ends of the ports *b g* with the valve V directly under the pan I. Also placed under these chambers is a passage T, which serves to connect the bottoms of the ports *c e* with the under side of the pan J, through the opening U. The ports *a*, *d*, *f*, and *h* are connected directly into the upper ends of the cylinder D E.

The rock-shafts R are operated by the pans I J, as will be seen; and these shafts operate the valves. Connected with each of the valves are two arms, which have their outer ends pivoted upon shafts supported a suitable distance above the partition B, by means of brackets, as shown. Secured to the rods or shafts between the ends of the arms are collars, which hold the arms against lateral movement upon the rods, and the valves in place upon or over their seats. The inner ends of these rods are connected with the valves by universal joint, so that the valves will seat themselves squarely and evenly upon the whole surface of their seats; and thus make at all times a gas-tight joint.

Connected at their lower ends to the valves 1 and 2 are links, which have their upper ends inclined towards each other, and pivotally connected to the inner ends of other links. The outer and opposite ends of the latter links are connected to the downward-extending arm of one of the rock-shafts R. In a similar manner, the valves 3 and 4 are connected to an upwardly-extending arm on the other rock-shaft; and, on the other side of the partition, the valves 5 and 6 are connected to a downwardly-extending arm on the last rock-shaft, and the valves 7 and 8 are connected to an upwardly-extending arm on the first-named shaft. Surrounding the openings U and V, and extending upward from the bottom of the chambers D E, are the walls G and H, of a shape corresponding to that of the pans, and fitting closely within them. This arrangement reduces to a large extent the amount of oil necessary to fill the chambers to the proper level, as shown by the dotted line. On the rock-shafts R arms are connected by links, with a crank on a shaft, which operates any suitable registering mechanism; and it also serves to keep the pans in the same relative position with reference to their stroke, so that, when one pan is at the end of its stroke, and its connection to the crank is on its dead centre, the other pan will be about the middle of its stroke—thus permitting a uniform rotation of the crank.

Owing to the fact that one valve of each pair forms the fulcrum upon which the other is raised, it is necessary for one valve of each pair to be properly seated before the other is opened. This prevents the opening of both valves at the same time, or the opening of one valve in each pair in advance of the closing of the other valve. Thus a common defect of ordinary meters is avoided.

In operation, the gas or air may be fed into either chamber L or N, as desired; the only effect being to reverse the motion of the meter. For the purpose of illustrating the operation, the port A will be described as the inlet, and the port B^1 as the outlet port.

As shown in fig. 1, the pan I is at the upper limit of its stroke, the pan J moving down, and gas passing from the chamber M through the open valve 4 to the chamber E above the pan, and forcing it down; while gas is passing from the under side of the pan J, through the passage T and port controlled by the valve 5 to the chamber L. The continued downward movement of the pan J opens the valve I, controlling the port communicating with the chamber D; and on the other side of the partition, it opens the valve 8, controlling the port which communicates with the pan I through the passage S, at the instant the pan I has reached the upward limit of its stroke. When the pan J reaches the downward limit of its stroke, the valve 4, controlling the port which communicates with the upper side of the pan, is closed; and the valve 3, controlling the port which communicates with the under side of the pan, is opened—thus admitting gas below the pan. At the same time, the valve 5 is closed, and the valve 6 opened, allowing the gas from the upper side of the pan J to escape through the port into the chamber L, and through the outlet-port B.

The valves 1, 2, 7, and 8, which control ports for admitting and exhausting gas to operate the pan I, are operated and controlled by one rock-shaft R, which is operated by the pan J; and the valves 3, 4, 5, and 6, which co-act with the pan J, are operated and controlled by the other rock-shaft R, which is connected with the pan I. From this, it will be seen that the valves which co-act with one pan are operated and controlled by the movement of the other pan. It will also be understood from the description that gas is fed to, and exhausted from, opposite sides of the pans, in a manner similar to admitting and exhausting steam to and from opposite sides of the piston of a steam-engine.

APPLICATIONS FOR LETTERS PATENT.

11,567.—CADOT, P., and CHARRON, A., "Electric lamp, gas, water, or motive force meter." June 13.

11,651.—WANSBROUGH, W. D., "Domestic gas-heated boilers." June 13.

11,734.—CUTLER, S., "Gas condensers." June 14.

11,762.—HAMILTON, J. H., "Gas or oil engines." June 15.

11,837.—CROOKE, W. T., and CARTWRIGHT, T., "Fuel for gas-fires." June 16.

11,871.—CRAIG, J. B., and HANCOCK, D., "Increasing the illuminating power of coal gas." June 16.

11,923.—HARRISON, C. H., "Argand or circular-flame gas-burners." June 17.

11,942.—ALLEY, S., and M'LELLAN, J. A., "Vessels for containing compressed or rarefied air or gas." June 17.

11,959.—DEPRESLE, H. E. A., "Regulator for atmospheric gas-burners." June 17.

11,961.—DEPRESLE, H. E. A., "Gas heating-stove." June 17.

11,964.—CROWTHER, H. W., "Treatment of the waste from gas liquor to obtain useful products therefrom." June 17.

A Water Scheme for Wotton-under-Edge.—Mr. T. Codrington, M.Inst.C.E., held an inquiry at Wotton-under-Edge last Thursday week relative to an application which had been made to the Local Government Board by the Rural Sanitary Authority for permission to borrow £3000 for the purpose of carrying out a scheme of water supply. The works have been projected by Mr. A. P. Cotterell, of Bristol; and the supply will be obtained from springs at Hamlin's Brake. The Inspector did not appear altogether pleased with the scheme, and suggested that it should be modified.

Buenos Ayres Water Supply and Drainage Company.—Last Wednesday week, the Liquidators of this Company signed the agreements with the various parties which will enable them to conclude arrangements with the Argentine Government for the settlement of all questions relating to the undertaking. The new contractors have undertaken to complete the works and put them in a going condition. Each shareholder will receive in due course a £10 Argentine Government bond in lieu of his £10 share. There have been very general expressions of satisfaction at the conclusion of the negotiations for the settlement of the above matter.

Southport and the Electric Light.—A special meeting of the Southport Town Council was held a few weeks since, for the purpose of further considering the scheme for the adoption of the electric light in the town. Alderman Hacking proposed that an electrical installation be put down in the town area. He stated that the estimated cost was £28,000, and that the borrowing powers provided for its repayment in 25 years. The scheme included the lighting of what was scheduled as the town area and the outside portions of the township. It was now found, after going to considerable expense, that £2000 more than originally estimated would be required. The yearly expenditure would be £3581, including £1608 for capital charges and £1873 for working expenses; while the income would amount to £1425—leaving a deficiency of £2156. He proposed that they should bring forward another scheme for lighting the town area only. After a long discussion, this was agreed to.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by our correspondents.*]

The American Gaslight Association and European Gas Engineers Visiting Chicago.

SIR,—Will you be so kind as to publish in the JOURNAL OF GAS LIGHTING the enclosed letter to the European gas engineers? My reason for this request will, I think, be sufficiently explained by the letter itself, which I desire to have brought to the attention of as many gas engineers and managers outside of the United States as possible.

Providence, R.I., June 13, 1893. A. B. SLATER, jun., Secretary.

[ENCLOSURE.]

Providence, R.I., June 5, 1893.

To the European Gas Engineers; greeting—

The American Gaslight Association will hold its twenty-first annual convention in the City of Chicago, beginning on the date of Wednesday, Oct. 18, 1893. It would give the members of the Association great pleasure to meet there as many of the European gas engineers and managers as can make it convenient to be in attendance at the World's Fair at that time. It is suggested that all contemplating visiting the Fair should arrange their visits so as to be in Chicago, if possible, at the time of this convention, when they will be most cordially welcomed by the Association, and invited to attend the sittings of the body, and participate in its discussions of papers presented. Those engineers who cannot conveniently visit the World's Fair at that time, but must choose some other date, are respectfully requested to send their names and addresses, as soon as they arrive in America, to the *American Gaslight Journal*, No. 32, Pine Street, New York City, so that a Committee from the Association may be made aware of their presence, and when they may be met, that they may form the acquaintance of their professional brethren in this country, and be made to feel less like a "stranger in a strange land."

A. E. BOARDMAN, President.
A. B. SLATER, jun., Secretary.

The New Method of Charging for Consumption of Gas.

SIR,—Your anonymous correspondent, "Fio," would make large consumers pay not only the same price for their gas, which is just, but also the same rate per 1000 cubic feet for the clerical, inspecting, collecting, &c., services rendered by the company, which are certainly not the same for the consumers who pay say a thousand pounds a year and a thousand pence.

As it is impracticable, and contrary to all precedent in this country, to divide the price into two or more separate items, the simplest and most satisfactory method is to allow a very moderate discount, proportioned to consumption. This is not, as "Fio" asserts, "in effect an allowance in the price of the gas," or done "to oblige a customer," but rather a means of avoiding a higher charge for gas, apart from services, to the large consumer than to the small one; and thus preventing, on the part of the large consumer, a natural feeling of dissatisfaction.

Mr. Walton Clark, of Philadelphia, has kindly sent me a copy of a paper, entitled "Meter-Rents—A Question of Equity and Policy," read by him before the American Gaslight Association in 1891,* in which he takes the view I have endeavoured to set forth. But, instead of discounts, he recommends a separate charge for "service," in proportion to consumption, under the general head of "Meter-Rents." He quotes from a decision by their "eminent Judge Baxter, of the Sixth Federal Circuit," on a railway case, where the Judge says that a railway "is, in a qualified sense, a public highway. Hence everybody constituting a part of the public, for whose benefit it was authorized, is entitled to an equal and impartial participation in the use of the facilities it is capable of affording. Freight carried over long distances may be carried at a reasonably less rate per mile than freight transported for shorter distances, *simply because it costs less to perform the service*." This applies with equal force to gas supply.

I trouble you with this because I feel it is of the highest importance, at this time, to secure the consumers' goodwill; and I believe in the dictum of Mr. Walton Clark, that: "Equitable treatment is a long step towards popularity."

"Fio" cannot have had much experience in gas supply, or he would never have said: "I think that, if gas companies established this principle [demand a cash deposit before giving a supply], they would displease consumers less than they do by cutting off the supply." By acting on this principle, they would offend *every* substantial consumer, and prevent many from having gas; whereas cutting off for non-payment, at the worst, only affects a small number of consumers, and would after all have to be resorted to, under his deposit system, when a deposit had run out.

I am glad to be able to agree with "Fio's" last paragraph, where he recommends a bonus to the staff of working men, if he would give it on the principle of profit-sharing, which is working with the South Metropolitan Gas Company most satisfactorily. GEORGE LIVESEY.

June 22, 1893.

"Hawkite" Gas.

SIR,—My attention has been called to a correspondence in your paper from Mr. E. J. M. Davies, in reference to certain results which he alleges he obtained with the blocks and apparatus of the Hawkite New Motive Power Company. Two things, however, he omits to state—namely, first, that he was, for a short while, in the service of this Company; and until he received notice that his services were no longer required, he spoke and wrote of the "Hawkite" invention in the highest terms. Second, that on April 19 last, after (to use his own words in the report) "an elaborate and careful investigation," he, in conjunction with two other engineers, drew up, in his own handwriting, and presented to the Directors, the following report:—

"Hawkite" Gas.

"We the undersigned have pleasure in submitting the following repor after an elaborate and careful investigation of the above gas.

"'Hawkite' is a trade mark applied to metal blocks and to generators manufactured by the Hawkite New Motive Power Company, and also to the gas produced, which is nearly pure hydrogen. The gas-bricks are specially prepared spongy metallic blocks, composed simply of waste scrap, wrought iron, or mild steel, which may be obtained in large quantities. They are placed in the patent generators, and are acted upon by diluted sulphuric acid; the yield being over 12,000 cubic feet per ton, or 5·4 cubic feet per pound of iron consumed.

"Among the many advantages of using Hawkite blocks for the evolution of gas, are the following: 1. Being in block form, they are less likely to rust than loose scrap iron, and are more suitable for transport; occupying only one-third of the space required for an equal weight of loose scrap iron. 2. Smaller generators are required for metallic blocks, thereby entailing less cost. 3. The blocks give a more uniform and steady yield of gas. 4. The blocks present a very large surface in a very small space for the acidulated water to act upon them.

"There is practically no waste in the production of the gas, as the bye-product, which consists of sulphate of iron (ferrous sulphate, copperas, or green vitriol), is a marketable and useful article, readily finding sale in London at about £2 per ton; and we believe a much higher price can be obtained in country districts. From 1 ton of iron consumed, and 1¾ tons of concentrated sulphuric acid required for its consumption, the yield of gas is over 12,000 cubic feet, and the crystallized sulphate of iron is over 4½ tons in weight. This bye-product is largely used for deodorizing, dyeing, manufacture of ink, as a preventive against rust in wheat, and many other purposes which greatly enhances its market value.

"The gas is quickly and almost instantaneously evolved, and can be used immediately on its leaving the generator, without any manipulation, such as scrubbing, &c. It can also be used at a low temperature. The weight of the gas is about one-fourteenth that of an equal volume of air. As compared with coal, Hawkite blocks occupy only one-fifth the space required for an equal weight of coal. The gas yield from coal is from 9000 to 10,000 cubic feet per ton; while that of Hawkite gas is over 12,000 cubic feet for the same weight. No fires or explosive oils are used either in the production or carburetting of the gas. It can be successfully applied to any gas motor; but we consider that, with a motor specially designed to meet the requirements of this gas, a much greater efficiency would be obtained. It would appear to be specially adapted for quick-running or high-speed engines, having a large diameter cylinder with a short stroke.

"As regards the explosive force in the cylinder of the gas-engine, we have found that Hawkite gas gives a considerably higher initial pressure than in the case of coal gas. Hawkite gas is especially suitable for purposes afloat, such as for the propulsion and lighting of launches, &c., and tramcars, for lighting railway trains, ballooning, &c. It would appear to be very suitable for torpedo or submarine boats. . . . One great advantage in the case of launches is that, for the purpose of diluting the acid used in the production of the gas. salt as well as fresh water may be utilized. The gas being so quickly evolved, the engine may be started in a few minutes; the generation of the gas being attended with perfect safety, as a low pressure (not exceeding 2 lbs. on the square inch) is attained in the generator, thereby reducing to a minimum all risk of explosion; and on boats using this gas there will be no smoke, dirt, or ashes, as is the case when steam power is used, also there will be no smell as in the case of oil-engines. If necessary, gas-tight compartments may be constructed to hold Hawkite gas, which, on account of its great buoyancy, would render the craft practically unsinkable.

"For the purpose of aërial navigation, a vast field is open for the application of this gas, which, being the lightest known gas, is especially adapted for this purpose. It can be manufactured in, and supplied from, the car of any balloon directly into the balloon itself; and being quite free from any flame, it is perfectly safe.

"Considered as an explosive, this gas possesses forty times the potential energy stored up in an equal weight of gunpowder; and it would appear that if it was mixed with the proper quantity of oxygen for combustion, to give the maximum explosive force, and was then introduced highly pressed into a properly made gun and fired, the propelling effect on a projectile would be considerable. Hawkite gas can be raised to almost any pressure by continuous evolution in a confined vessel of proper construction; and thus it presents characteristics which would make it compare very favourably with compressed air, which requires complicated and costly machinery for its compression.

"As an illuminating agent we have found that Hawkite gas possesses a superior illuminating power to coal gas, when used in a Welsbach or other incandescent form of burner.

"There is no doubt that many other applications for this gas will be found on its further development."

The above results of his "elaborate and careful investigation," compared with the misleading and erroneous statements contained in his correspondence in your paper, written as soon as we dispensed with his services, show how much, if any, reliance can be placed on Mr. Davies as an expert. Permit me to thank you for allowing "Hawkite" to occupy so much of your space, and to say, in conclusion, that the cost of the gas is much lower than Mr. Davies estimates, and that the defects of the apparatus, both as regards motive power and illumination, have been rectified.

THOS. A. BRAMSDON, Secretary,
Hawkite New Motive Power Company, Limited.

Portsmouth, June 23, 1893.

The Maidstone Water Company's Works.—The annual conference of the Sanitary Inspectors' Association was held at Maidstone a few weeks since, when one of the principal features was a visit to the works of the Maidstone Water Company, at Fonstall and East Farleigh. At the former place, the visitors were received by Alderman Ellis, the Chairman of the Water Company, and Mr. J. Ware, the Engineer. At East Farleigh the party were entertained to luncheon; and Alderman Ellis then gave a short account of the work of the Company. He said it was formed in 1860, and now supplied about 215 million gallons of water a year to the inhabitants of the district. The plant is capable of distributing 1000 gallons a minute, which is double the present requirement. The engine, which was purchased in 1878 for £6000, has only cost since then about £250 for repairs. The coal required for pumping 1000 gallons of water to the reservoirs at Barming is 5·7 lbs. The visitors expressed their great satisfaction with what they saw, and accorded their hearty thanks to Alderman Ellis and Mr. Ware for their kind reception.

* The text of the paper referred to by our correspondent appeared in the JOURNAL for Dec. 1, 1891, p. 991.—ED. J.G.L.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Bills last week:—

Bills read the first time: Electric Lighting Provisional Order Bill (No. 7); Greenock Corporation Bill; Water Provisional Orders Bills (Nos. 2 and 3).

Bill committed: Leeds Corporation (Consolidation and Improvement) Bill

Bills reported: Barnoldswick Local Board Bill; Bodmin Water Bill; City of London Electric Lighting Bill.

Bills read the third time and passed: City of London Electric Lighting Bill; Electric Lighting Provisional Orders Bill (No. 4); Gas Provisional Orders Confirmation Bills (Nos. 1 and 2); Water Provisional Orders Confirmation Bill (No. 1).

HOUSE OF COMMONS.

The following progress was made with Bills last week:—

Bill read the first time, and referred to the Examiners: Gas Orders Confirmation Bill.

Bill read a second time and committed: Electric Lighting Provisional Orders Bills (Nos. 5 and 6).

Bills referred to a Select Committee, consisting of Mr. S. Smith (Chairman), Mr. Cavendish Bentinck, Mr. Channing, Mr. Wingfield Digby, and Mr. Bonham-Carter (Referee), to meet on Tuesday, June 27: Crystal Palace District Gas Bill; Bilston Commissioners (Water) Bill; Belfast Water Bill.

Bills reported: Electric Lighting Provisional Order Bill (No. 7); Pontypridd Local Board Gas Bill; Runcorn Commissioners (Water) Bill; St. Helens Corporation Bill; Water Provisional Orders Bills (Nos. 2 and 3).

Bills read the third time and passed: Electric Lighting Provisional Order Bill (No. 7); Greenock Corporation Bill; Water Provisional Orders Bills (Nos. 2 and 3).

HOUSE OF COMMONS COMMITTEE.

(*Before Mr.* A. de Tatton Egerton, *Chairman; Mr.* H. E. Hoare, *Mr.* J. Scott-Montagu, *Mr.* A. Holden, *and Mr.* Bonham-Carter.)

Monday, June 12.

ACCRINGTON GAS AND WATER BILL.

The Bill promoted by the Accrington Gas and Water Company for the purpose of authorizing them to raise additional capital, which was passed by a Committee of the House of Lords in March last (see *ante*, p. 550), came before a Select Committee of the House of Commons on May 15; but, owing to the approach of Whitsuntide, the consideration of the measure was adjourned until the above-named day.

Mr. Littler, Q.C., Mr. Meysey Thompson, Q.C., and Mr. Claude Baggallay appeared for the promoters; the opponents—the Corporation of Accrington, and the Local Boards of Church, Clayton-le-Moors, and Rishton—being represented by Mr. Pember, Q.C., Mr. Cripps, Q.C., and Mr. J. D. Fitzgerald.

Mr. Littler, in opening the case, stated that the Company had gone rather longer than the usual number of years since they last applied to Parliament; and, as they asked for additional capital, there were other matters which would have to be adjusted. The further amount proposed to be raised was £160,000. When the Bill was originally deposited, there was no proposal to divide the capital; but this had since been thought desirable, and, indeed, had been strongly pressed upon the Company by Lord Morley. By adopting this course, it enabled the Company to include the sliding scale in connection with their gas undertaking. It had therefore been provided that the existing gas capital should be £100,000, of which £4500 should be called "A," and £95,000 "B" gas capital. The existing water capital was to be £130,000, of which £6000 would be "A," and £124,000 "B" water capital. The proposal now was to issue £104,000 of "C" gas shares or stock, and £56,000 of "C" water shares or stock. The dividend on the new capital was to be limited to 7 per cent.; and the auction clauses would be adopted. The present maximum price of gas was 5s. per 1000 cubic feet. Only 3s. 6d. was charged, however; and the standard fixed in the Bill was 3s. 9d. The reason the new capital was needed was that the district had grown very rapidly, and enlarged gas-works were required. With respect to the water supply, the works were adequate; and, notwithstanding the dry season, they had sufficient for 310 days. At present the water was not filtered; and it was proposed to construct filters, and a high-pressure reservoir 750 feet above Ordnance datum. The opponents in the other House abandoned their allegation that the water was of bad quality—Professor Wanklyn, their own chemist, having pronounced it to be excellent; but he was sorry to see they were again trying to raise the question before the Committee. The death-rate in the district was only 15 per 1000; so that this was a good test of how well the Company had carried out their duties. The standard illuminating power of the gas was proposed to be 15 candles, which in service would represent an ordinary power of 17 candles. The price charged for the water was 50 per cent. lower than it was at Blackburn; while the Corporation of that town charged 3s. 7d. per 1000 cubic feet for their gas, and lost £6000 a year in the operation. Southport and Darwen were also in the same position of losing upon the gas supply. Under these circumstances, he was a little puzzled to find that the Local Authorities were opposing the Bill. The learned Counsel commented upon the petition of the opponents, especially that part of it which suggested the purchase of the undertaking of the Company by arbitration; but he submitted that the Company did not want to go to arbitration, and that they could not be compulsorily dispossessed of their property unless misbehaviour were proved. If the Company had been guilty of this, the Local Authorities should bring in a Bill of their own on the subject; but it would be contrary to precedent to put a clause in the present Bill providing that the Company should sell their undertaking. The opponents alleged that the Company had expended out of income large sums of money on capital account, and, "for the purpose of concealing it, had manipulated and altered their books of account to the serious injury and detriment of the consumers." Such a charge he characterized as monstrous, and said that, though some sort of charge was made before the Lords Committee, it was absolutely given up.

Mr. *C. Harrison*, Secretary and Manager of the Company, was then examined; and he gave details as to the capital powers, the increase of consumption, and the reductions in price that had taken place from time to time. He said that from 1888 to 1892 the price was 2s. 10½d. per 1000 cubic feet; but the anticipated advance in coal, and a suggestion made in the negotiations with the Corporation for the transfer of the undertaking, led to the raising of the charge. A considerable capital expenditure was at present necessary if the work of the Company was to be carried on properly. It was proposed to remodel the works to some extent, and to supply a larger quantity of gas from the Great Harwood station, and less from Accrington, as they would be able to produce it more economically at the former place. A considerable portion of the supply being to mills, a good extent of storeage was essential; and he considered they ought to have at least 50 per cent. margin. The whole of the present money powers had been exhausted on permanent works—leaving no capital for carrying on the undertaking; and one of the reasons for asking for the additional amount was to provide for the latter. With regard to the water-works, the Company had a storeage capacity of 560 million gallons; and on the 8th of June, they had in stock 426 millions—allowing 20 gallons per head per day for 70,000 people for 304 days. There was therefore an ample supply; but they had no proper filter-beds—only settling reservoirs. The Company had decided to construct one filter for each of the five reservoirs, which would prevent turbidity; and, on the advice of Mr. W. B. Bryan, they also proposed to construct a high-level reservoir at Great Harwood. Witness was examined with reference to the financial management of the Company, and said that, upon the advice of Mr. Michael, they had paid deficiencies in back dividends amounting to £8481 out of undivided profits; such a course being authorized by the shareholders. In the allocation of expenditure to revenue or to capital, the Directors had acted in what they considered to be the interests of the Company, but never with any intention of postponing reduction of price to dividend. They had not yet commenced the formation of a reserve fund. The only way in which they had declared higher dividends than were authorized by their Acts was by paying the full dividends without deducting the income-tax, as was done by many other companies; but supposing that this was wrong, and that the income-tax ought to have been deducted, there was still a balance due to back dividends which would more than counterbalance it. He denied that there had been great complaints as to the arbitrary raising of the price of gas without notice; and with regard to the suggested supply of polluted water, he said there had been only complaints about one reservoir, and the defect would be remedied by the construction of a filter. The "pollution" arose from a vegetable deposit during high temperature; and the results of analyses proved that it was in no way detrimental. Other allegations in the petition were replied to by the witness, who denied that there had ever been any manipulation of the books, or any concealment, or even a figure altered after the audit during the last sixteen years. There had never been any need for such a thing; and the allegation was absolutely false from beginning to end.

In cross-examination by Mr. Fitzgerald, as to using revenue for capital expenditure, witness said he did not think that if, instead of applying surplus profits to the reduction of the price of gas, they devoted them to new capital expenditure, it was an injury to the consumers, if done in a reasonable way. He did not, however, admit that they had done so. It was not the fact that, within the last ten or twelve years, they had expended between £20,000 and £30,000 out of revenue for capital purposes. They had spent upon new offices £5500, of which £5000 was put to revenue, and £500 to capital. A large amount laid out upon a reservoir, in making it water-tight, had been charged to revenue.

Mr. Fitzgerald was about to cross-examine the witness upon other items, when

Mr. Baggallay said he would not object to any questions based upon the published accounts or balance-sheets; but if they were founded upon facts ascertained by the Corporation officers, who, by arrangement, were allowed to inspect the Company's books without prejudice, he must do so entirely, and would take the opinion of the Committee upon the matter.

The Chairman, after some discussion, said the learned Counsel could cross-examine the witness upon the published documents, but not upon any information which had been obtained, under the seal of secrecy, in the course of the negotiations.

Mr. Cripps then made an application for the production of the Company's books.

After some further discussion, the Committee consulted in private. Upon the re-admission of the parties,

The Chairman said the Committee felt that it was not necessary, in the face of Counsel having the balance-sheet before them, to produce the books. If there was, according to their allegation, fraud, there was another tribunal before which it could be tried; but, for the purposes of the Committee, and of the allegation in the petition, the balance-sheets were sufficient.

Mr. Cripps said he accepted the decision of the Committee; and, in order not to raise the question again, he might say that they accepted the full responsibility of the allegation they had made. They could not prove it without reference to the books, so they must leave it where it was. They considered it was very material that this should be understood before the Committee granted fresh powers to the Company. The balance-sheets would not prove it, as the question was how these were made up from the books.

Mr. Baggallay: The balance-sheets could be taken before the Court of Quarter Sessions and examined.

Mr. Cripps: We make the allegation now. We are prepared to

prove it; but we cannot do so without the books. Speaking for the Corporation, we think it is a most important issue.

Mr. FITZGERALD then proceeded with the cross-examination of the witness as to the relative price of gas in Accrington and other places in the neighbourhood, and especially as to the statement that the charge was raised at the instigation of the Town Clerk in the course of the negotiations; but he maintained that it was partly in consequence of such a suggestion that the figure was put up. Correspondence on the matter was read to the witness, in which there was no suggestion of the kind; but the witness insisted that it was made at a personal interview, the date of which he could not give, except that he thought it was in the beginning of September last. He was further cross-examined with regard to the illuminating power of the gas, which he said was not less than that of gas supplied in any other borough in Lancashire.

Mr. FITZGERALD remarked that, if the proposal in the Bill were sanctioned, the Company would be supplying in Accrington worse gas at a higher price than in any other borough in Lancashire.

Witness was next cross-examined as to the non-deduction of income-tax for dividends. He said he did not think the Town Clerk had called his attention to the fact that it was illegal; but he did not know. The advice of the Town Clerk's father-in-law, who was a solicitor at Clitheroe, was to go on as they were then doing in this respect. The question of transferring the undertaking to the town had been agitated at various times.

Mr. BAGGALLAY took exception to the question of the transfer being discussed on the present Bill; arguing that there was no precedent for putting a purchase clause into the Bill of a company on a hostile petition. There was no Joint Board of the several Local Authorities opposing, and no scheme for carrying out such a suggestion.

After some discussion, the Committee deliberated.

The CHAIRMAN said it was so important a question—it being one of the great points alleged on the part of the petitioners—that he thought the Committee ought to hear sufficient evidence about it.

Witness then detailed the course of the negotiations, after which the Committee adjourned.

Tuesday, June 13.

At the opening of the proceedings this morning,

Mr. LITTLER referred to the discussion which had taken place on the previous day as to the production of the books; repudiating, in strong language, the suggestion that there had been any fraud or deliberate falsification of them for the purpose of defrauding the consumers. He invited the Mayor, or any one of the Aldermen or members of the Local Boards, to make the charge outside the Committee-room, so that the matter might be tried before a Court of Law.

Mr. PEMBER stated that criminal fraud was not alleged, nor was there any charge of fraud in the sense in which the word was ordinarily understood by lawyers. He simply adhered to the terms of the petition, and said the Company could meet that by the production of their books.

The CHAIRMAN said that the allegation was certainly very strongly drawn; but, if the Counsel on behalf of the Corporation and the Local Boards stated that it did not take the form of criminal fraud, he thought Counsel for the Company should accept that.

Mr. MEYSEY THOMPSON said he could not admit that there had been any irregularities whatever.

Mr. *Harrison* was then further cross-examined by Mr. FITZGERALD as to pollutions of the water, and as to the land possessed by the Company upon which works might be carried out. While this was proceeding,

Mr. LITTLER interposed, and said that, rather than there should be any suggestion as to any sort of alteration or manipulation of the books having taken place, he had advised the Directors to remove the seal of secrecy so far as the books were concerned, though not with regard to the negotiations; and they had telegraphed for every book for the last ten years, so that the witnesses might be examined on the books. He should challenge the opponents to prove any one of those allegations; and if their Counsel found there was no ground for his imputation, they would expect an ample and humble apology.

Mr. FITZGERALD accepted Mr. Littler's offer; but he said he would like to have the books for the past fifteen years.

Mr. LITTLER asked that all the books should be sent for.

The examination of the witness then concluded.

Mr. *W. B. Bryan*, M.Inst.C.E., said he had advised the Company as to what should be done with regard to the water-works; and he gave details of the average rainfall, the system of reservoirs in use, and their storeage capacity. He did not propose any additional works for the purpose of increasing the available supply of water; but he had recommended the construction of a small high-level reservoir, and the provision of filter-beds. Effectual filtration through sand was an improvement to all moorland waters, as it removed in a great measure the organic matter; and expenditure in this direction was a perfectly proper thing for the Company to incur. A sum of £5000 was put down for working capital, and £6000 for contingencies and improvements to the Mitchell reservoir. There was no ground for stating that any of the works he had recommended were put in for the purpose of filling up the capital account; for every one was a work which he should strongly recommend.

Witness was cross-examined by Mr. FITZGERALD as to the immediate necessity for the works which he admitted. It was suggested that none of them were mentioned in the Bill, nor was there anything to compel the Company to construct the works. Witness, however, said he did not think there was any necessity for them to be mentioned. He first visited the place last December, when it was too late to deposit plans; but he had consulted with the Solicitor for the Bill before it was deposited. He did not think it was deposited with the view of "dishing" the Corporation with regard to the negotiations. The Company had spent all their capital; the Corporation threw over the negotiations; and it was absolutely necessary, if they were to carry out the works which the Company's engineers had suggested as being necessary, to issue notices without delay, so as to be in time for this session.

Mr. *J. Newton*, M.Inst.C.E., gave evidence as to what had been done by the Company in the way of carrying out works for the prevention of pollution. He expressed the opinion that turbidity would be removed by the filtration works now suggested; and said he considered that, independently of any question of enhancing the value of the concern for the purposes of transfer to the Corporation, the expenditure proposed ought reasonably and fairly to be incurred for the benefit of the undertaking.

Mr. *T. Newbigging*, M.Inst.C.E., said he knew the Company's works, as he had valued them for assessment, and had recently visited them for the purpose of the Bill. The plant and appliances were in good condition, and well maintained, although they were old. There was some difficulty in respect to the carting of coal at the Accrington portion of the works; and he had therefore recommended reducing the manufacturing power there, and increasing it at Great Harwood, where the works were of more recent date, and adjoined a railway. One of the proposals for the expenditure of capital under the Bill was to put in siding accommodation. The Great Harwood works were in splendid order. It was proposed not only to extend them, but to lay a special main to the gasholders at Accrington. The storeage capacity at present was 40 per cent. in excess of the make; but, in his opinion, there should be at least 50 per cent. excess, though 75 per cent. would really be better, as it would enable the Company to carry on their undertaking with greater economy. The works were well managed; the leakage being only 6 per cent. He estimated that, in the course of the next twelve years, £120,000 would be required for extensions, enlargements, and additional plant, and there should be £15,000 of working capital. The proposed illuminating power of 15 candles was the usual standard specified now-a-days when a gas company came to Parliament; the standard in 55 per cent. of the whole of the gas-works in Lancashire being as low as 14 candles. He did not consider there was any necessity for an extra testing-place, though, if the Corporation chose to have one at their own expense, there could be no objection. He knew of no precedent whatever for the insertion of a compulsory purchase clause in a Bill of a company which merely asked for fresh money powers, especially where there were seven Local Authorities, as in this case.

In cross-examination by Mr. CRIPPS, witness said he considered £400, at present prices, would be the cost of works per million cubic feet of gas; and he could not agree that from £250 to £350 would be the outside figure. It was his experience, in actual practice, that the development of existing works had cost at the rate of £500 per million cubic feet. Witness was cross-examined at some length upon comparative instances of other towns as to the margin of storeage capacity desirable and the illuminating power required; also as to whether his estimate of 19·89d. per 1000 cubic feet of gas sold, for working expenses, including interest on debentures, was not in excess of the figure worked out in other towns. He gave details of the items upon which his estimate was based, and insisted that it was correct.

Wednesday, June 14.

On the resumption of the inquiry this morning,

The CHAIRMAN asked if the books of the Company had arrived.

Mr. LITTLER replied that they had; and the other side could see what they wanted.

The CHAIRMAN said, under these circumstances, it would save the time of the Committee if the petitioners gave them, in the shortest manner, the inspection they required as to any particular points upon which they wished to examine.

Mr. FITZGERALD asked that the books should be handed over to his Accountant, so that he might go through them.

The CHAIRMAN replied that they could not have a roving commission through the books. The opponents had made a definite statement, and apparently on evidence which they had obtained without prejudice; and if they had this evidence, it was only fair to the Company that they should state the specific dates on which they wanted to examine the books.

Mr. FITZGERALD remarked that, if the Accountant were allowed to go through the books, they would be able to indicate in every case the year, the day, and the page, and to mark the places, so that the Committee, after hearing the evidence, could say, with regard to each particular allegation, if it was right.

Mr. LITTLER said the petitioners should state whether or not they relied upon the charges in the petition. If they did not, they had no right to go through the books. If they did know that in some particular year there was a certain manipulation, and that in another year there was another manipulation, they could say so; and, unless they showed it, he asked the Committee to rule that it should not be gone into. They were now face to face with the allegations; and the Company's Accountant would inspect the books, and answer the allegations. The petitioners either knew what the charges were, or they did not. If they did not know, they had no right to fish for them.

Mr. CRIPPS said he was quite ready to meet Mr. Littler, and to tabulate the alleged instances of manipulation of accounts, by which they meant the statement of accounts in such a way that the consumers did not get what they were entitled to under the General Gas Acts. He submitted that they should have inspection of the books in order to bring first before the Committee the figures in relation to those instances. They did not want to travel all over the books. They said that the accounts had been manipulated to the disadvantage of the consumers in certain specific ways, and at certain specific times.

Mr. LITTLER called attention to the fact that the charge was that the Company had from time to time expended large sums of money out of income on capital account, and, for the purpose of concealing the manipulation, had altered their books, to the serious injury and detriment of the consumers. The proof must be confined to that paragraph, otherwise they would be wandering all over the books.

Mr. CRIPPS agreed that this was the point; and he said he did not wish to go outside that allegation. He promised that in the course of half an hour a list of the instances in which this had been done should be copied, and placed in the hands of the other side.

Mr. *Newbigging* was then recalled, and further cross-examined by Mr. CRIPPS as to the basis of his estimate of 19·89d. per 1000 cubic feet for working expenses, including interest on debentures. He said

6·14d. for repairs was a proper figure, and was reasonable as compared with other companies much larger than that at Accrington. At Sheffield, it was 6·51d.; and at Bristol, 5·33d. The average given in Mr. Field's "Analysis" was 3·96d.; but it was unfair to take the averages of a dozen large companies, and compare them with a small one like the Accrington Company. The price of coal he placed at 14s. 2d.—the same as was at the time being paid; and he said he was distinctly of opinion that the price in the future would be conspicuously much higher than it had been in the past. He knew of no precedent in which a Committee had insisted upon a purchase clause being introduced into a Bill, except in the case of the Sheffield Water Company.

In reply to Mr. BONHAM-CARTER, witness said that £35,000 of the new capital must be spent immediately; and, in calculating the price of gas per 1000 feet, he took into consideration the dividend payable upon that £35,000. Generally speaking, the increase of capital met with augmentation of profit; but in this case there would have to be a considerable expenditure (including a new main from the Great Harwood to the Accrington station) which would not be profitable.

Mr. *E. H. Stevenson*, M.Inst.C.E., said he agreed with Mr. Newbigging as to what was necessary to be done at the Accrington works. The Great Harwood works were excellent, both in design and in construction; but the Accrington works were old, and not what would be erected now, though the scrubbing and exhausting apparatus were the only parts really deficient. The cost of the repair and maintenance of the old works would necessarily be rather large. He considered that the expenditure for increased storeage was necessary. They had only something like 36 per cent. of margin; and in a mill district, with foggy weather, there ought to be much more than this. The capital proposed would, he considered, carry the Company forward about twelve or fourteen years. He thought the amount per million cubic feet of gas was very moderate. The works had been well managed; and considering that the district was a mining one, and bearing in mind the length of the Company's mains, the leakage was very small. He submitted a table giving his estimate of the cost of gas for 1894, which came out at 3s. 6·70d.; but, there being a difference of 3d. between the large and small consumers, the prices to be charged should be 3s. 8·20d. and 3s. 5·23d. to pay the standard dividends. He therefore thought the standard price of 3s. 9d. sufficiently low. He knew of no case of a statutory gas company in which a Committee had insisted upon the insertion of a purchase clause.

At the close of this witness's evidence,

Mr. MEYSEY THOMPSON stated that the list as to the books had been handed to the promoters' Counsel, and would require careful examination by their Accountant.

Mr. LITTLER, in suggesting that there should be an adjournment at that stage, said there was another consideration which had come before them. Persons did not cling to a gas or a water share as a matter of affection; and all those things were properly questions of price. Certain proposals had been made to them by the Corporation, which might be satisfactory; and, if so, the Company would have no objection to inserting, by agreement, a purchase clause in the Bill. But supposing they were not satisfactory, the question which had been raised upon the books would require careful investigation; and he suggested that there should be a reasonably long adjournment to enable further negotiations to take place.

The proceedings were then adjourned.

Stourbridge Improvement Commissioners' Gas-Works.—An inquiry was held at Stourbridge last Thursday, by Mr. F. H. Tulloch, one of the Inspectors of the Local Government Board, with reference to an application by the Improvement Commissioners for sanction to borrow £5000 in connection with the purchase of the gas-works. The application was made at the time notice was given of the intention to acquire the works, when it was calculated that the money would be needed for working capital. It has since been proved that in all likelihood the money will not be required; the working capital having been otherwise provided. After hearing a statement by the Town Clerk (Mr. H. Mills), the Inspector proceeded to the gas-works to make an examination; and it was understood that, in the event of the money being needed, he would report in favour of its being borrowed.

The Use of Prepayment Meters in Liverpool.—In a recent issue, the *Liverpool Mercury* gives an interesting account of the introduction into that city of the prepayment gas-meter. Our contemporary says the meter has come into popular favour with almost phenomenal speed. The whole credit of launching it into use is due to the Gas Company, who started by placing 50 of the new meters experimentally in the artizans' dwellings in Cazneau Street. In 1890, more than 100 meters were at work in Liverpool; and from that time until now, the difficulty has been to construct them quickly enough to supply the enormous demand which now exists. In 1891 the Company fixed 1975 meters; in 1892, 4038; and now there are between 8000 and 9000 in the houses of those who hitherto have depended upon candles or oil for the illumination of their homes. The Company receive, on an average, upwards of 100 applications per week for these meters, from people who live in houses and cottages of small weekly rents.

Action to Recover Rent for a Gas-Stove.—His Honour Judge Ellison had before him, at the Sheffield County Court last Thursday, a case in which the Sheffield Gas Company sued John Siddell, a solicitor's clerk, to recover £2 0s. 3d., the rent of a gas-stove let to him at 1s. 9d. per quarter. Plaintiffs (who were represented by Mr. W. E. Clegg) claimed for rent for five years and three-quarters, although it was stated that the defendant owed rent for eight years. Owing to defendant's changes of address, plaintiffs had lost sight of the stove, and discovered it by accident. Defendant pleaded that the claim was barred by the Statute of Limitations (which plea Mr. Clegg described as shabby), and also that the plaintiffs had lost their right to possession of the stove. His Honour held that defendant was wrong with regard to the amount which had been claimed. The rent accrued at the end of each quarter; and whether or not plaintiffs were negligent, it was his duty to tender the amount due. He ordered payment of the whole of the debt by the 3rd prox.

MISCELLANEOUS NEWS.

THE METROPOLITAN WATER SUPPLY COMMISSION.

(*Lord* BALFOUR OF BURLEIGH, *Chairman*; *Sir* G. B. BRUCE, *Sir* A. GEIKIE, *Professor* DEWAR, *Dr.* OGLE, *Mr.* G. H. HILL, *and Mr.* J. MANSERGH, *Commissioners.*)

Thirtieth Day—Tuesday, June 20.

At the close of the sitting of the Commissioners on Feb. 15 last—the 29th day of the inquiry—it may be remembered that the Chairman announced that, as far as they were then advised, they had taken all the necessary evidence. Early in the present month, however, it was intimated that an additional sitting would be held; and this took place last Tuesday.

Dr. *G. Sims Woodhead*, F.R.C.P.E., Director of the laboratories of the Conjoint Board of the Royal Colleges of Physicians and Surgeons, and Editor of the *Journal of Pathology and Bacteriology*, was the first witness. In reply to the CHAIRMAN, he said that for several years he had been engaged in bacteriology, especially in connection with pathology, but also with hygiene. In 1885 he was associated with Professor Greenfield in a bacteriological examination of the waters of the Tweed and the Tay; and he had from time to time superintended or advised in several investigations on the behaviour of bacteria in water carried on in the laboratories under his charge.

In answer to Dr. OGLE, witness said the science of bacteriology was quite in its infancy, and in such a state that they were still groping in the dark. They had, however, gained some information in connection with the relation of bacteria to water and sewage. Laboratory experiments, where they were able to control the conditions under which organisms might be kept, often gave almost opposite results from those that they were led to expect from the behaviour of organisms in their natural surroundings. Therefore, too great reliance must not be placed on the numerous experiments that had been carried out, and on any deductions that might have been drawn from the results obtained. For instance, all the experiments made in regard to the vitality of the cholera organism when brought into contact with other organisms, as in fæces or sewage water, led them to believe that the cholera bacillus would very soon die out; but recently it had been proved that this was not so. There were so many factors to be considered, that at present it seemed impossible to determine the one on which most stress must be laid. He agreed with other witnesses who had told the Commissioners that there was no doubt some diseases were produced by bacilli; and that the bacilli could maintain their existence for a longer time in water.

Dr. OGLE: You probably agree that the only two diseases that need be taken into account in connection with water supply are typhoid fever and cholera?

Witness: Yes; in this climate.

There is no reason, in the present state of bacteriological science, to suppose that such diseases as diphtheria, erysipelas, summer diarrhœa, and tuberculosis are communicable by drinking water?—That is so, with the exception of summer diarrhœa.

Is there any evidence to show that summer diarrhœa is caused by the drinking of water?—No; not any direct evidence.

Now, seeing how uncertain and unsafe are all deductions made from bacteriological experiments, and how contradictory the experiments themselves are, does it not appear to you that, for practical purposes, we must rely, if not entirely, yet mainly, upon experience?—We must rely mainly upon experience. We cannot accept a great number of the earlier experiments as reliable, because the conditions were not exactly understood. Some of the more recent experiments are rather more accurate; and therefore I think we must lay more stress upon the results obtained.

If we are to trust to experience, I suppose you would say that, if we found that the consumption of a given water was habitually accompanied, among those who consumed it, by an excessive amount of typhoid fever, we should reject that water, whatever the bacteriological or chemical examination might be?—Certainly.

And if we found by experience that a given water was consumed for a long period of years with perfect apparent impunity, we should, whatever bacteriological investigation might show, accept that water as practically wholesome?—No; I do not think so.

Why do you draw the distinction—in one case rejecting it, and in the other case accepting it?—In the one case you have the positive, and in the other the negative experiment; and although the conditions may be such that you have no outbreak of typhoid for a very long period, still the water may be in such a condition, and contain such materials, that, if the typhoid bacillus happened to find its way into the water, that water might become exceedingly dangerous.

Even if we allowed that to be theoretically possible, and if we found that a huge population—say, of four or five millions of people—had for years been consuming that water without any harm, the experiment would be on such a gigantic scale that it would outweigh that theoretical possibility to which you point?—Of course, an experiment so far would outweigh any other consideration; but if we found, for instance, a similar case where there had been water consumed for a great length of time, but this water contained certain organic matter, and if there had been an outbreak in a similar state of affairs—that is with like conditions of water, after a long period of absence of disease—then I should say that this ought to be taken into consideration in discussing the case.

Can you point to any case in which water of a great river, treated in the same way as the water in London, and delivered under precisely similar circumstances, has been drunk for a length of time with perfect immunity, and then has caused a great outbreak?—I do not know that there is any river or any water supply which is just in the same condition as London; and therefore it is difficult to state what would happen exactly under those conditions elsewhere.

But I thought you were asking us to take into consideration the occurrence of cases of typhoid fever produced under the same circumstances as the water we are dealing with?—I think the matter must

be divided into two branches. If we take Hamburg, for instance, we know that the water supply had not altered, but suddenly there was an outbreak of cholera.

But that water was not delivered under the same conditions as London water. If we found, by experience, that water delivered under certain conditions of filtration and so forth was consumed by millions of people for a series of years without any harm whatever, might we not, in the present state of bacteriology, conclude from this experience that the water was wholesome, and might be drunk with impunity for the future?—Of course, it is such a large experiment that it must be accepted as having very strong weight; but at the same time, I would not try that experiment upon myself.

You would not drink any London water?—Not without first treating it myself as I should wish to do.

But there are millions of people who are drinking it?—Yes; and, of course, I accept that as being an important experiment, and very important evidence in favour of its being comparatively free from anything which would produce disease.

But if bacteriology is, as you candidly allow, at present in such a state that we are only "groping in the dark," and are warned by you not to draw any deductions for practical purposes from it, what other plan have we of considering whether or not the water is wholesome than to know that it has been consumed for years with impunity?—I think you ought to be very guarded in drawing these deductions.

You are aware that tables have been put before us by various witnesses, among them by the Medical Officer for the London County Council, showing that in London, taking a series of years, the mortality from typhoid fever has been lower than in any other of the large towns where the water supply is utterly beyond all suspicion?—Yes.

Then, with regard to the typhoid bacillus, can you tell me how long it has been known to live in water?—It has been said to live 15 days; and even longer in river water. In water diluted with sewage, it would live a shorter time.

Consequently, if there was an amount of fæcal matter lying upon the foreshore or upon the surface of the ground anywhere, and a flood came and washed it down into the river, we may confine ourselves, so far as the danger of typhoid fever goes, to the deposit that has occurred within the last week or fortnight, or some limited period of that kind?—I think that is probably the case. At the same time I may just say that quite recently I have had my faith rather shaken in that, as I have had to examine some material from a sewer in which I think I have got the typhoid bacillus apparently after somewhere about three weeks; but I am not quite sure as to the diagnosis. It was a choked sewer, and had been so for about three weeks; and it must have been three weeks since any typhoid matter went down it.

Then fæcal matter lying upon the surface of the ground, and washed down by a flood into the river, would only be dangerous for a limited period?—Yes; so far as we know from laboratory experiments.

I believe this typhoid bacillus is supposed not to have spores?—There are no ordinary spores.

Consequently, there is no reason for the supposition that spores would be maintained in vitality, although the bacilli themselves would have died?—That is a matter of controversy at present. Some hold that there are certain bacilli, developed under unfavourable conditions, which remain alive much longer than the ordinary typhoid bacillus; that is, that it becomes so modified under certain conditions that they can retain this vitality, when it is in unfavourable surroundings, much longer than can the ordinary typhoid bacillus grown under the usual conditions. It is certainly the case in cholera; and it is supposed to be in typhoid also.

But that does not apply to the typhoid bacillus when it is in fæcal matter, but rather when it is put under special conditions?—We do not yet know the exact conditions.

Are there not many which interfere with the vitality of the typhoid bacillus when it is in water?—Yes.

Assuming that a certain number of typhoid bacilli are poured into the river at Oxford, what are the conditions, before reaching London, that would interfere with the bacillus maintaining its vitality?—One is the action of light—in clear water, of course; not quite so well in muddy water.

You mean such water as the Thames; that would be clear?—Comparatively clear.

The ordinary nature of the light on the Thames would be such as to affect the vitality of the bacilli?—Yes, certainly. Then there is oxidation; but I had perhaps better leave that out now. Then there is the effect of the putrefactive organisms, which would hardly exert an influence in diminishing the vitality of the typhoid bacillus. Then there is the rapidity with which the organism develops.

When you say that they interfere with its vitality, you mean that they consume it?—Whether or not they eat it we cannot say; but it is probable that their products interfere with the growth of the typhoid bacillus. It is found, however, that these putrefactive organisms grow most rapidly in water when there is a considerable quantity of organic matter; and the typhoid bacillus certainly grows faster where there is a considerable quantity of organic matter. But although it grows more quickly, it dies sooner.

Consequently the conditions in the river water are favourable to the destruction of the typhoid bacillus by the putrefactive bacteria?—Yes, by the putrefactive bacteria; but, where they are present in large numbers, there is no doubt that the typhoid bacillus doos not live so long as it does where there are fewer putrefactive organisms. That, of course, is to a certain extent modified by the amount of organic matter, of sedimentation, and of light.

Then is the flow of the river in itself such as to exercise any effect upon the typhoid bacillus?—I do not know that it affects it so much as to allow of the more rapid oxidation of the products of the organisms. Typhoid bacillus has never yet been found in a rapidly-flowing river; but it has been met with in slowly-flowing rivers, and in ponds, wells, and anywhere else where there is practically stagnant water. The typhoid bacillus always comes from drains, water-closets, privies, and so on.

Then, altogether, there are a very considerable number of agencies which tend to the destruction of the typhoid bacillus in its flow for miles down a river?—Yes. Its natural *habitat* is in the body.

Then the case stands that all bacilli, when they are out of their natural *habitat*, become what is called attenuated—that is, they lose their virulence. On the other hand, the putrefactive bacteria would be in their element; and, in the internecine war between the two, this would give a great advantage in the river to the putrefactive bacteria over the others?—Certainly.

When we take all these things into consideration, the number of typhoid bacilli which would come down to Hampton would be extremely small?—Very small indeed; and, if everything were always properly carried on, I think the danger would be exceedingly small in the water from the Thames Valley.

You are aware that there are 999 per 1000 of bacteria found to be removed by filtration, as it is carried out by the Water Companies drawing from the Thames. So that, by the time the water found its way into the mains, the chances of there being any typhoid bacilli in it would be extremely minute?—Very much diminished. But we have to take into consideration the enormous number of microbes that are found in certain waters; so even if you remove 999, that still means that a very considerable number of organisms may be in a volume of water.

Do you mean that an extremely small number may pass through, yet a single one, if it gets into a cistern, may there multiply to such an extent as to be dangerous to all the people in the house who consume that water?—Yes.

Now, there are in London some 750,000 cisterns. Does it not appear to you to be a very strong argument against that happening that, though the cisterns have been in use for years, no outbreak has ever yet been known to be caused by the consumption of the water in a cistern, except when it was locally polluted?—It is certainly a very strong argument.

I understand you to say that only floods which occur in the summer time have to be dreaded?—Yes; when you have comparatively a high temperature.

In the ordinary conditions in the river, one may say that the effect of light and the presence of other bacteria act with greater readiness on the cholera bacillus than on the typhoid bacillus?—Yes.

Professor DEWAR: Are you aware that Dr. Koch advised the German Government that the water supply of Hamburg should in future be practically identical with the London supply?

Witness: Yes.

Are you also aware that, during the cholera epidemic, where the same water was treated similarly to the London supply, there was no outbreak from it at Altona?—I had heard that the outbreak was not so great, where the water was settled and filtered. I did not know that there was no outbreak.

Are you aware of the bacteriological methods which have been applied on a large scale by the State Board of Health of Massachusetts to filters as they are actually used and constructed for water supply?—Yes.

The report says that "the deeper filters are much safer than the more shallow ones"—I may mention that they go from 1 foot to 5 feet—"that low rates are safer than high rates; and that, at the same average rates, continuous is quite as effective as intermittent filtration in the removal of bacteria. The results clearly show that, with due care in the selection of the filtering material, filters can be constructed and operated at rates up to 1,500,000 to 2,000,000 gallons per acre daily, with the removal substantially of all the bacteria. These results leave no room for doubt as to the efficiency of suitable filtration as a safeguard against water-carried diseases." Do you agree with that?—I agree with it in the main.

So that you are not prepared to deny, from experience, the conclusion that filtration can remove, if not absolutely the whole, substantially the whole of the organisms?—I agree with that.

Personally, if you have a river water to use, you would select that river where you have the least contamination from a living population on the surface. You are well aware that there are a very large number of populations in England, apart altogether from London, that are supplied by river water?—Certainly.

With reference to the multiplication of bacilli contaminating a water supply, would you think it would be removed if there was double filtration?—I should say it would be very much diminished.

You are aware that there is a very varied condition of the environment of the river from its source to the intakes of the Water Companies; so that, apart altogether from the action of light, from sedimentation, and from the causes—aëration, and so on—of which you spoke, this continuous change in the environment is probably a very important factor?—Very important indeed.

Are you aware that, in the case of the Massachusetts Commission, they found that as much as 98 per cent. of the total number of bacteria in a highly-polluted river were removed simply by storeage, without any filtration at all?—I did not know that it was such a high proportion.

Would you say that the contamination of a well, or of a supply from the chalk, by any typhoid dejecta would be much more serious than in the case of a river?—I think it probably would.

Is it not a fact that you might have the purest rain water, and that the typhoid bacillus would develop in that quite as easily as in the case of a river water?—Not necessarily so easily. There must be food for it to allow it to develop in rain water. There must be a certain quantity of albumenoid matter for the typhoid bacillus to develop easily, just as the cholera organism cannot develop its poisons unless you supply it with a certain quantity of albumenoid material.

The CHAIRMAN: I understand you are in favour of sand filters not being less than 3 feet thick?

Witness: Yes; I consider that the layers should be of sufficient thickness to keep back the organisms, and to allow the lower layers to be some distance from the growing layers of organisms which are kept back.

Is there any other point?—The only other point is about the dose of the poison. We have to bear in mind that the condition of the alimentary track plays such a very important part in allowing of the growth, not only of the typhoid, but also of the cholera organism. It is a well-known fact that, in cholera epidemics, a large number of people may take the same milk or water, whatever the material has

been derived from, and that only a certain proportion of those will become affected with cholera. It is found in all cases that there has been some predisposing cause; and it further comes out, I think, from Pettenkofer and Emmerich's experiments that there may be a mild form of cholera produced by the taking in of poison—that is, of bacteria which have been cultivated outside the body—for some time.

Mr. *D. D. Wilson*, General Manager of the Stockton and Middlesbrough Water Board, was next called to give evidence on the report of Dr. Barry, the Local Government Board Inspector, respecting two outbreaks of enteric fever in the Tees Valley in the autumn of 1890 and the spring of 1891.

The CHAIRMAN observed that the Commission were going into this part of the inquiry to make it as complete as possible, and because the two outbreaks of typhoid fever which took place in the autumn of 1890, and in the early weeks of 1891, in Stockton, Middlesbrough, Darlington, and some of the surrounding districts, had been mentioned to the Commission by several witnesses—notably by some of those from the London County Council. The Commission thought that, in some of the districts, the condition of affairs had a distinct bearing upon the questions committed to them. The Commission had hoped to have signed their report by this time; but, owing to the delay in getting the report from the Government, they had been prevented doing so. Even now it was only owing to the courtesy of the Medical Department of the Local Government Board, in supplying them with proof copies of their report, that they were enabled to proceed. It was very desirable that the report of the Commission should be issued as early as possible.

Witness, in answer to the CHAIRMAN, said that the tenor of Dr. Barry's report suggested that the object of the inquiry was not so much to arrive at a knowledge of the real facts as to the origin of the epidemic, as to fix the responsibility for its outbreak in the water supplied in the neighbourhood by the Darlington Corporation and the Stockton and Middlesbrough Water Board. Dr. Barry had simply endorsed the opinion of the Medical Officers of the district, that the water pumped from the River Tees during the floods of August, 1890, had produced the epidemic. In Dr. Barry's final report, it was stated that, except the water supply, there was nothing, "such as elsewhere has been found," to disseminate enteric fever in common between the various districts supplied with Tees water. But in every part of the area served with Tees water, there were insanitary conditions such as had been found over and over again to produce enteric fever in every part of the county; and Dr. Barry had not attached due weight to them. He should have paid some attention to the facts set out in the report on Dr. Ballard's exhaustive inquiry, two years before, into an outbreak of fever in the neighbourhood of Middlesbrough, which, in the course of a few months, proved fatal to 490 persons, and which Dr. Ballard attributed to the insanitary conditions which he found everywhere abundant. Again, Dr. Barry made no mention of the fact that in Stockton, at the time of the epidemic, there were 100 cases of continued fever, although in all the other places in the Tees water supply district these were classed as typhoid. Witness produced maps to show the cases of enteric fever in the district before the autumn epidemic; and nearly all of them occurred at a period when Dr. Barry said enteric fever was not epidemic in the country. In some places these cases were more numerous than those which occurred during the epidemic. In the interim as well as in his final report, Dr. Barry laid much stress on the fact that small villages, such as Old Ormesby, Yearby, Kirkleatham, and Dimsdale, should have escaped the epidemic; but the fact was omitted that the village of California, which contained nearly as many houses as all these four villages put together, also escaped entirely, although it was supplied with Tees water, and was in the district of a Local Board in which the attack rate was 115·6 per 10,000 for those who used Tees water, and 40·4 for those who did not. At one time, Dr. Barry entertained the opinion that climatic influences and sanitation might have had some slight connection with the course of the epidemic; but apparently he had forgotten to deal with those matters in his report. For anything that appeared to the contrary, the epidemic of enteric fever in Teesdale in 1890–91 might have made its appearance, for almost the first time in the history of Tees-side, three weeks after the floods in the river in the month of August, 1890. Witness then dealt with Dr. Barry's report *seriatim*. Dr. Barry had asserted that the outbreak of the epidemic in September, 1890, was practically confined to the Tees water supply districts; those outside being practically exempt. This was not so; and Dr. Barry was misled as to the comparative prevalence of fever in the various districts, by dealing with numbers of cases ascertained by several different methods—viz.: (1) In the Tees water districts, by compulsory notification; (2) in the other districts, by voluntary notification; or (3) personal application to medical practitioners. The voluntary notification was totally unreliable; and even compulsory notification signally failed to procure information as to disease sufficiently early in the case to be really useful as a preventive to the spread of infectious diseases. The Registrar-General's returns of deaths showed that, during the first three quarters of 1890, there was as much prevalence of fever in the adjoining districts as in the Tees water districts; and that, after the end of the third quarter of 1890, "spreading" was the principal factor in producing the cases. Next, Dr. Barry asserted that the fever was epidemic in every part of the Tees water supply district, and was simultaneous in its outbreak in each part. This was not so; for it never touched California—a village with 162 houses—which, in all previous outbreaks of fever, used to suffer greatly, before the Tees water supply was introduced in 1884. In the first outbreak it was practically absent from the old part of Stockton, with 900 houses; and the cases were extremely few in the second outbreak, while every one was associated with serious sanitary defects. Witness mentioned other districts where the fever was wholly absent. These places, which entirely escaped the first epidemic, contained far more houses than those situated in the Water Board's district, but not supplied with Tees water, which escaped in the first outbreak. Then the assertion that the outbreak was simultaneous in every part of the district was not correct, as the statistics which witness put in clearly showed. The fact was, the sanitary arrangements in the various districts did not differ more in 1890-91 than they did in previous epidemics, and especially those which occurred in Stockton and South Stockton in the spring of 1890, which were not attributed to the Tees water, but to insanitary circumstances and conditions. Witness maintained that the Tees water was certainly not the cause of the epidemic. The Water Board had storeage for 12,000,000 gallons of water; and in the different service reservoirs, there were 37,000,000 gallons, or a total of 49,000,000 gallons. This would be about five days' supply. They filtered the water at the rate of about 5 inches an hour. The average weekly pumping might be taken at 63,000,000 gallons; the daily at 9,000,000 gallons; and the hourly, at 375,000 gallons. Asked as to whether the floods running down a valley like the Tees would not be short and heavy, witness replied that in the course of 24 hours the water had risen 15 ft. 8 in. and subsided. The intervals between cleaning the filter-beds, in the absence of floods, were governed entirely by the state in which they happened to be. If the river had had a long course of clear water, the filters would go without cleaning for a considerable length of time; but very rarely more than two months.

Thirty-first Day—Wednesday, June 21.

Mr. *Wilson's* examination was resumed this morning.

In reply to the CHAIRMAN, witness said the filter-beds were 5 ft. 6 in. in thickness; and the extent of their filters was 5·26 acres. The quantity of water filtered per superficial foot was 2·64 gallons in 24 hours.

In answer to Mr. MANSERGH, witness said the Darlington Corporation's works were entirely separate from those of the Stockton and Middlesbrough Water Board; but the water was obtained from the Tees at practically the same spot. The water supplied to the whole of their district was treated at Broken Scar. Witness described the general arrangements for getting rid of the sewage of Stockton. They had two or three different systems of sewers, with various outlets. Referring to a map of Stockton, witness said that ancient Stockton, with 6000 inhabitants on 70 acres, was the worst drained; and the larger number of cases of fever occurred at the ends of the sewers. The main sewers were not ventilated at all, either by surface ventilation or by shafts. Since the epidemic of 1891, they had started a new system of drainage; and they hoped it would be a most complete one. This showed that the epidemic of 1890 and 1891 was attributable to the bad drainage, and not to the water supplied by the Water Board.

Sir G. BRUCE: You attribute the quantity of fever rather to the bad drainage than to your water?

Witness: That is my case—that the fever was due to insanitary circumstances, and not to the water.

And you say that the remedy lies in the alteration of the sewers, and not in an alteration in the supply of the water?—Yes. The water supply is just the same as it has been during the last forty years. My view is that, if the sewers were properly ventilated, it would be a step in the right direction.

In answer to questions by Dr. OGLE, witness recapitulated the principal points in his evidence.

Replying to Professor DEWAR, witness said the system of filtration employed by the Board was like that of most water companies—in fact, Hamburg was going to take their system as a model. With regard to the bacteriological examination of water, it was stated that, whatever the contamination might be, three-fifths was due to the sewage of Barnard Castle. There was a flood of water from Barnard Castle for 17 miles before the water was taken in at the intakes; and this water had a heavy fall and came down in a tumultuous style. It had been ascertained that the water supplied to the intakes was as good as the water before it reached Barnard Castle. This water had been examined through the whole 17 miles; and there was no substantial difference in chemical composition between that taken at the intakes and that above Barnard Castle.

The CHAIRMAN thanked Mr. Wilson for his evidence, which would, he said, be of great assistance to the Commission in coming to a right conclusion. He added that they would hear Dr. Barry on the 30th inst.; and this would absolutely conclude the taking of evidence.

Extensions at the Bideford Water-Works.—The water supply of Bideford is to be improved by the construction of filter-beds, at an outlay of £1113. The contract has been secured by Messrs. Perrin and Long, who have been building a reservoir for the Local Board.

Water Scheme for Ellesmere.—The Ellesmere Local Board have decided to make an agreement with the Liverpool Corporation for a supply of water from the Vyrnwy aqueduct. The water will be furnished at 6d. per 1000 gallons. The Corporation will undertake the cost of laying the necessary pipes, estimated at about £1300, on which the Local Board will pay interest at the rate of 7 per cent., 2½ per cent. of which will go towards a sinking fund to pay off the capital, and 1 per cent. for maintenance.

Electrolytic Action on Gas and Water Pipes.—In our "Electric Lighting Memoranda" to-day reference is made to the opening of the inquiry by the Joint Committee of the two Houses of Parliament, into the question of the insertion of protective clauses in Private Bills relating to electric traction. As the result of an answer given by Mr. W. H. Preece in regard to the connection of gas and water pipes with the conductors, Mr. Pope, Q.C., last Tuesday made an application for the Gas Companies to be represented before the Committee, as they had found that the use of gas-pipes, as a link in the return current, had been recommended and actually adopted in one provincial town. The Companies thought there was great danger in such a proposal; and they desired to give evidence thereon. Later in the day, the Chairman (Viscount Cross) stated that the Committee had considered the question raised by Mr. Pope. He did not think there was any reason why either the Gas or the Water Companies should come before the Committee to cross-examine every witness; but if they, within the terms of the reference, would like to be heard, and to propose some restrictions in their interests, the Committee would hear them. He added that the Committee considered the case of the Companies identical. They would therefore admit one counsel on their behalf; and they might call their own witnesses to say in what manner they would like to be protected.

ELECTRIC LIGHTING FOR YARMOUTH.

Local Government Board Inquiry.

The application of the Yarmouth Town Council to the Local Government Board for sanction to the borrowing of £15,000 for the purpose of introducing the electric light into the borough was the subject of an inquiry by Mr. F. H. Tulloch yesterday week. At the outset, a deputation from the Ratepayers' Association was introduced; and they protested against the scheme. The Town Clerk then proceeded with the case for the Corporation. He gave a brief account of their proceedings in regard to the matter; and stated that on Dec. 13 last, they resolved to carry out a scheme, at an outlay of £15,000, to supply 50 to 100 arc lamps for public lighting, and 4500 lamps for private lighting. He reminded the Inspector that during the present year the Local Government Board had sanctioned 13 loans to towns for the supply of electric lighting. Nine applications had not yet been sanctioned; while 16 other towns had made application for loans for this purpose, and were awaiting Local Government Board inquiries. Last December a public meeting was called at the Town Hall; but it was promoted by the opponents of the electric light scheme, and, as the result, resolutions were adopted against it. The Corporation had also received a memorial signed by 164 ratepayers, requesting that the town should be polled on the question; but he explained that the Corporation possessed no power to do this. The Borough Surveyor, replying to the Inspector, said the cost of lighting the streets in the area in question by gas was £500; while by electricity it would be increased to £734. He believed, however, that the light afforded would be augmented to the extent of ten times the present illumination. Mr. W. H. Preece, jun., stated that in Yarmouth the high tension system—one working at a pressure of 2000 volts—would be used. If, on the average, each shop and house took 30 lights, only 110 customers were needed to make the system pay. The light would be supplied at 6d. per Board of Trade unit, as against 8d. at Norwich. The Chairman of the Electric Lighting Committee (Mr. R. Martins) believed that 3200 lights would readily be taken by the traders in the town. Two shopkeepers gave evidence, in the course of which they seemed to be very sanguine that the concern would pay; and one of them declared that at the present time his stock was depreciated to the extent of £50 annually through gas. The statements made on behalf of the opponents of the scheme showed that they took no exception to the electric light, but they did not think it was expedient it should be introduced on such a large scale.

THE GERMAN CONTINENTAL GAS COMPANY.

Report and Accounts for 1892.

We have received, as usual, a copy of the annual report of the Directors of the above Company, of which Herr W. von Oechelhäuser is the General Director; and we extract therefrom the following particulars:—

The general depression in trade in 1892 has made itself felt in the business of the Company, though to a less extent than its intensity would warrant us in anticipating. Since the foundation of the Company in 1856, the production of gas has steadily advanced, year by year; and 1892, notwithstanding adverse conditions, proves no exception to the rule, though the increase is less marked than in many previous years. The total production of the Company last year was 36,392,790 cubic metres (1,285,248,000 cubic feet) of gas; being an increase of 1,094,426 cubic metres (38,651,000 cubic feet), or 3·1 per cent., on that of 1891, which, however, was a rise of 5·53 per cent. on that of 1890. On the other hand, the number of burners in use showed a far larger proportional increase in 1892; exceeding that of any former year, and pointing to a rapid dissemination of the use of gas as a source of light among small consumers. The high price of coal ruling in 1891 continued during the first half of 1892, and was not compensated by a correspondingly high value for coke, except in districts far removed from the coal mines. The stocks of coals had been very large at the close of the preceding financial year; and an increased production of coke at the pit mouth had also tended to depress the market for that commodity. Tar and ammonia fetched bad prices; and depreciation in the value of the rouble caused the profit of the Warsaw station to dwindle.

The recent appointment of town inspectors, and the introduction of the new improved incandescent gas-light, increased the number of consumers; more than 8000 incandescent lights having been put up in the Company's district within eight months, at an expenditure by the consumers of more than £7000. In view of the general depression of trade, these figures show that the new light has given a great impetus to the gas industry. Further improvement and economy may be anticipated in the incandescent burners in the future. Notwithstanding the reduced consumption of gas where the incandescent light has replaced old burners, the total has not been diminished, as many new customers have been attracted through it who have hitherto used the electric light or some other illuminant. It has been adopted in many cases where the old burners were impracticable; while they continue in demand where heating and ventilation are required in conjunction with lighting. The new burner has, at a very small increase in the cost, immensely improved the public lighting of the towns served by the Company. The competition of the electric light has been less keenly felt than in some previous years. It cannot be considered competitive where gas-engines are used for its production, as they are to the extent of about 432-horse power in the Company's districts. An important new application of gas has been indicated in the adoption of gas motors for the street tramways in Dresden. The horse power of motors which has been found most suitable for compressing gas for this purpose is from 5 to 8; and thus the well-known economy of the gas-engine is secured, and a small capital outlay only is required. Another system of gas-motors is to be tried on the tramway from Neuchâtel to St. Blaise; and experiments will be made with a third system by the Company in conjunction with some firms in Dessau. The application of gas for heating and cooking purposes has come more and more into vogue. The Directors of the Company consider that only somewhat improved trade in general is required to put it and the gas industry at large in a thoroughly prosperous position.

Turning to the detailed statements in the report, it is noticeable that nearly 37 per cent. of the gas made is consumed in private houses, nearly 20 per cent. in factories, and 18 per cent. in street lighting. A diminution on the preceding year's consumption is observed in the case of factories only, where it amounts to 2·1 per cent. on the total; while the gas consumed for the generation of power has increased by more than 20 per cent. The average consumption per burner in private lighting was 8·31 cubic metres (2935 cubic feet); and in public lighting, 455·9 cubic metres (16,100 cubic feet). For yielding heat and power, 11·83 per cent. of the total production was used; the gas for motive purposes alone amounting to 6·9 per cent., and supplying 583 engines, giving 2555-horse power. The length of mains was 697,168 metres (about 430 miles), against 672,070 metres in the preceding year. The average price paid for coal was 2·01 marks per 100 kilos. (very nearly 20s. per ton); being 5 per cent. less than in 1891. English, Westphalian, Silesian, and other coals were used. The yield of gas was 29·1 cubic metres per 100 kilos. (10,400 cubic feet per ton) of coal. Coke sold for 1·99 marks per 100 kilos., or slightly less than 20s. per ton; while tar fetched only 4·53 marks per 100 kilos., and the value of ammonia was lower than in the previous year.

The Company's works at Frankfort-on-the-Oder, Potsdam, Luckenwalde, Warsaw, Gotha, and Ruhrort have increased their output slightly; those at Nordhausen and Lemburg, considerably. Those at Gladbach, Hagen, Erfurt, Dessau, and Herbesthal, however, have fallen back; the two latter greatly, owing to economies exercised by railway managers and manufacturers. The electric lighting installation of the Company at Dessau increased its output by 25·8 per cent.; and the cost of production was lower than in 1891. The electric light there is chiefly used for lighting the Ducal Palace; and the increase is due to a larger consumption in the theatre attached to it.

The gross profit of the Company for the past year was 2,257,792·92 marks, which is 101,244·62 marks less than in the preceding year. The net profit of 1,734,156·42 marks suffices for the usual dividend of 10 per cent., after making additions to the reserve and renewal funds.

Extension of the Dinsmore Process at the Widnes Gas-Works.—The Widnes Town Council have decided, upon the advice of their Gas and Water Engineer (Mr. Isaac Carr), to extend the Dinsmore process to four additional beds of retorts prior to next winter. The system upon which the extensions will be made is that which has been in successful operation at the works during the past four years.

Exhibitions of Gas Appliances—During the past week, the Davis Gas-Stove Company, Limited, held exhibitions at Gosport and Witham; Miss E. Johnston lecturing at the former, and Mrs. Springthorpe at the latter place. Messrs. W. Parkinson and Co. exhibited their gas cooking and heating stoves last week at Shipston-on-Stour and Ashby-de-la-Zouch; Miss Sanderson giving lectures and demonstrations in the last-named town. Messrs. R. and A. Main, of Glasgow, last week held an exhibition of their cookers and heaters in Dundee. The firm have received an order from the Dundee School Board for 18 of their cookers for use in cookery classes in the schools.

Sales of Shares.—Last Tuesday, Messrs. Cobb sold, at Rochester, a number of shares in the *Rochester, Chatham, &c., Gas Company*, as follows: Four "A" (£50) shares, with a dividend of 10 per cent., at £113 each; one similar share at £112 10s.; and another at £112. Twelve "C" shares in the same Company, on which 7 per cent. dividends are paid, and on which £3 6s. 8d. had been paid up, realized £5 each. Twelve "D" (£8 10s.) shares, bearing interest at 10 per cent., fetched £19 10s. per share.——On the following day, Messrs. Baxter, Payne, and Lepper sold, at the Bell Hotel, Bromley, the 200 ordinary 7 per cent. shares in the *Bromley Gas Company* recently advertised in the JOURNAL. They were disposed of as follows: 70 at £16 5s. each, and 130 at £16 7s. 6d. each; the total realized being £3266 5s., or an average of £16 6s. 7d. per share.

Subways and Gas and Water Mains.—The Bill introduced by the London County Council last session to obtain power to make subways in the Metropolis came last Thursday before the Earl of Morley, Chairman of Committees of the House of Lords; being revived at the stage at which its progress was suspended in 1892. The only question at issue arose in connection with clause 12, which contains a proviso holding the Council liable, as between themselves and the Gas and Water Companies, for accidents which may occur to their pipes during, or in consequence of, the construction of subways under the Act. Mr. Rees, representing the Water Companies, submitted that the words of the proviso imposed a limitation which would expose them to actions in the first instance. A verbal amendment was inserted to meet this objection; and the Bill was ordered to be reported.

Misapplication of Money of the Gas Workers' Union.—At the West Ham Police Court last Thursday, William H. Ibbitson, 32, a labourer, was charged on a warrant with misapplying £1 11s., and withholding certain books, the property of the Barking Road Branch of the Gas Workers' and General Labourers' Union. Mr. Morton, who prosecuted, said the various Branch Secretaries of the Union had to render to the Chief Secretary a statement of receipts and expenditure. Prisoner was the Secretary of the local branch at Barking Road, but since November last he had not made any return, though repeated applications had been made to him to do so. He was a paid Secretary, receiving 3d. per member per quarter; and he received these sums until March 18 last, when he disappeared. His books disappeared, so that the exact amount he had misapplied could not be ascertained. He himself had said he had lost the books, and that the total amount appropriated was £8; but it was only within the power of the branch to prove his receipt of 31s. The prisoner now simply entered a plea of "Guilty." Mr. Baggallay said he would make an order on the prisoner to deliver up the money and books, and pay a fine of 20s. In default of doing so, he would go to gaol for six weeks with hard labour.

BELGRANO (BUENOS AYRES) GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at Winchester House, Old Broad Street, E.C.—Mr. C. P. OGILVIE in the chair.

The notice convening the meeting having been read, it was agreed to take as read the Directors' report and accounts, which were referred to in last week's issue.

The CHAIRMAN, in moving the adoption of the report and accounts, said the shareholders would observe that, for the first time, the accounts were shown upon the gold basis; and, in his opinion, this was the only way in which they should be handed to the English shareholders. In last year's accounts, they had an item of £43,652 as the net revenue; but against this was the loss on exchange and exchange suspense, amounting to £51,755. This had been completely swept away; and they had been able to bring back an old asset of £5000 in reserve. With regard to the sale of gas, he was happy to state that the private consumption had increased at the rate of 7 per cent.; but there was a diminution in the public lighting, which had been of great advantage to the Company. He asked the shareholders to give their earnest attention to this, for he wanted them to support the Directors in what they had done. The old concession expired on the 11th of November, 1891—that was according to the reading the Municipality put upon the contract which was originally entered into. There was another reading which made the concession terminate at a later date; but the difference was only a few months, so that it did not matter much. During the negotiations for a fresh contract for the public lighting, the Directors modified their proposals, and tried to meet the Municipality in every way; but, when the document they sent in was presented to the Council, the Board were much surprised to find it was thrown out. They then put every possible obstacle in the Company's way—they prevented them opening the streets, and refused their tariff, with the result that the Directors sent out a telegram to the Manager, instructing him not to light the public lamps at all. He maintained the Directors were perfectly right in doing this, because they were taking money out of the pockets of the shareholders for the purpose of making gas for which they did not know whether or not they would get paid. Their Manager took the telegram to the then Lord Mayor; and an arrangement was come to. The Municipality accepted the Company's terms; but a clause was inserted to the effect that they did not do so in perpetuity. Since this contract was arranged, the Municipality had paid and met the Company very fairly indeed; and he thought they might look forward to the municipal account being kept within bounds. Speaking next of the capital expenditure, he said that in 1891 it was £12,716; while in the past year it was £5276. Of this sum £3000 had been spent in providing new house services and outside cocks for turning off the gas. Up to the present, a consumer could burn gas, and when called upon to pay the money, if he felt inclined, he could laugh in his sleeve; and the Company had no remedy. It was true that only in one particular case had this happened; but the Directors feared it might occur in others. They had also enlarged their coal-sheds at a cost of £1500; and some plant had been erected for the purpose of distilling the tar. When he was last in Buenos Ayres, they were making tar at a very great rate; it was accumulating, and was a source of trouble to the Manager. This led to the erection of the distilling apparatus, which cost very little, but the effect was very peculiar. Although they converted a large portion of the tar into pitch and oil in the past year, they had sold $15,000 worth of the raw material. In 1891, they were not able to get more than $4911 for the whole of the tar produced. The other Companies were also working up their tar; and the consequence was that the demand for it probably remained the same, but the supply was cut off. The total result was that in 1892 they realized $23,000 from their tar. The Directors were sending out additional plant, and hoped to further utilize the bye-products. Referring subsequently to the cheapness of house and steam coal in the Argentine Republic, he stated that he could buy coal which had been raised at Cardiff at a cheaper rate in Buenos Ayres than in London—in fact, he could purchase it there at something under £1 per ton; and this state of things had had an adverse effect on the sale of coke. He made brief allusion to the account owing by the Government; and then, speaking of the Company's prospects, said that, although the gold premium was then rising in the Argentine Republic, he thought the future looked a great deal brighter than the past. In concluding his speech, he read a telegram which had just been received from their Manager, as follows: "Prospects are very much more favourable. The receipts are increasing. Everything is now satisfactory."

Mr. A. HOOPER seconded the motion.

In the course of a brief discussion which followed,

Mr. ALFRED RICHARDS remarked that the shareholders must all feel the Directors had adopted a wise course in the position they took up with regard to the public lighting; and it appeared to him to have been justified by the very satisfactory arrangement which resulted.

The CHAIRMAN, in reply to a question, said they had intentionally brought down the price of the public lighting to such a figure that they gained very little from it, because, if they made money out of it, others might come into the district to undertake it, and perhaps they would also take away some of the private consumption. He was glad to find, from the remarks made by Mr. Richards, that the Directors had the support of the shareholders in what they had done.

The retiring Directors (Messrs. Ogilvie and Hegan) and the Auditors were re-elected; and afterwards a special vote of thanks was passed to the Directors and the officials for the admirable way in which they had conducted the negotiations with the Municipality.

The proceedings then terminated.

Bexhill Water and Gas Company.—At an extraordinary meeting of this Company last Friday week, it was agreed to increase the capital by the creation and issue of 1000 new ordinary shares of £10 each.

Additional Water-Works for Budleigh Salterton.—The Budleigh Salterton Local Board have accepted a tender, submitted by Messrs. Hawkins and Best, of Teignmouth, for the construction of a pumping-station, reservoir, and other works, at a cost of £1080.

GAS-ENGINES AND PUMPS AT THE ROYAL AGRICULTURAL SOCIETY'S SHOW.

An interesting feature of the Royal Agricultural Society's show at Chester, which closed last Friday, was the attractive stand of Tangyes Limited. As our readers are aware, the firm have lately turned their attention to the construction of gas-engines; and with such good results that this branch of their business has developed considerably. The first motor calling for notice is one constructed in accordance with Pinkney's patents. These engines are made in sizes ranging from ½-horse up to 115-horse power; their principal use being for driving machinery of delicate construction. For this purpose the makers claim that they have special characteristics—viz., freedom from shock, steady running, proportionate distribution of metal to resist strains, &c. Several improvements have been effected in these engines which render them economical, whether running at high or at low speeds; so that, if required for ordinary work in the daytime, they can be easily utilized for electric lighting purposes at night. The firm are devoting much time and capital to the further development of the larger-sized gas-engines, to utilize producer gas. They had at the show a 25-horse nominal engine, indicating 62-horse power; a 7-horse engine, indicating 15-horse power, driving a saw-bench; and smaller sizes—5, 3, and ½-horse power, indicating 10·5, 6·5, and 2·5 horse power—doing various kinds of work. Passing to the other class of motors, the Company's girder steam-engine, with 16-inch cylinder and 32-inch stroke, was typical of its series. This engine has been thoroughly revised throughout, so as to stand a working pressure of 100 lbs. per square inch; and all the details bear evidence of the great care bestowed on it. Pump construction is a branch of the Company's business which has brought them a universal reputation. The "Special" steam-pump on view at Chester, which was 12 in. by 8 in. by 24 in., was a good example of a type of pump made in hundreds of combinations, and for every conceivable duty. To meet the recent general rise in steam pressures, the cylinders are strong enough for a working pressure of 100 lbs. per square inch, and the pump for a total head of 300 feet. The "Special" pump is also made in other forms for heads of 600 and 1000 feet, and for use in hydraulic work to pump against pressures up to 2½ tons per square inch. Tangyes' horizontal duplex pump, having 6-inch steam cylinders, 4-inch water cylinders, and 6-inch strokes, has been designed mainly for boiler feeding where high steam pressures are usual. It is made to work with and against a pressure of 160 lbs. per square inch. The Company make a large number of these pumps of various types suitable for heads of 300, 600, and 1000 feet, and to work against hydraulic pressures of 500 lbs., 1 ton, and 2 tons per square inch. The Company's other exhibit consisted of a sliding and screw-cutting lathe; a circular saw-bench; and a "Soho" engine with governor, mounted on a Tangyes' colonial boiler—an arrangement specially suitable for country use where wood or other inferior fuel is abundant. All these appliances combined to make an effective display of the Company's specialities. The other well-known gas-engine makers—Messrs. Crossley Bros., Messrs. Fielding and Platt, Messrs. J. E. H. Andrew and Co., and Messrs. Robey and Co.—had a good display of their various makes of motors. Referring again to pumping machinery, the most recent achievements of the Pulsometer Engineering Company, Limited, were to be seen at their stand. Their latest efforts have been directed to increasing the steam economy of the pulsometer, without detracting from its advantages in respect of durability and handiness. An example of this is the "Grel" neck, the action of which corresponds to a cut-off valve on the back of the main slide in an ordinary engine; the steam actuating the pump being worked expansively. A No. 5 pulsometer thus fitted was shown at work, as well as a "Criton" pump—a single-acting pump of the same class. The Company had on view a "torrent" filter, capable of purifying 1000 gallons of very dirty water per hour, working as nearly as possible under the same conditions as would obtain in actual use. The exhibits included a Deane sinking-pump, suitable for raising about 3300 gallons of water per hour from a well or shaft 200 or 300 feet deep; a No. 11½ pulsometer, suspended on chains, and capable of throwing 80,000 gallons of water per hour; a "Caryl" fly-wheel pump; and a marine duplex pump—the whole making an excellent show.

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly Meeting of this Company was held last Thursday, at the Offices, Commercial Road, Pimlico—Sir W. H. WYATT in the chair.

The SECRETARY (Mr. G. H. Gill) read the notice calling the meeting; and the report of the Directors was taken as read.

The GOVERNOR, in moving the adoption of the report, said he thought the proprietors would regard the accounts as very satisfactory, and what to is mind made the position more satisfactory was the steady increase in the revenue. The Directors did their best to maintain the income of the Company. But, unfortunately, they could not keep down the costs to which they were subjected; and therefore, in the long run, they were not left with any great benefit. The parliamentary expenses to which they had been put were very considerable. The frost had also caused some outlay; but this was a matter which could not be helped. The rates and taxes, as the shareholders were all probably aware, continued to increase; and he really did not know the amount to which they were going to rise. Altogether, the past half year had been an anxious time; but nevertheless he thought that the outcome of the working for this period had been very satisfactory. During the present extreme drought—of which no one, he believed, could remember the like—they had experienced no trouble in supplying their consumers with water; but the way in which some of them wasted the water was shameful. It was very difficult to discover an instance; but if they could bring a clear case against any consumer they would do so. There was, however, no doubt whatever that millions of gallons were wasted. Fortunately, on the advice of their Engineers, something like 1½ miles of new 24-inch main had been laid between

Putney Bridge and Stamford Bridge; and this had been of immense help in increasing the pressure, and affording a better supply to the lofty buildings in the eastern part of the district. The work had been exceedingly well done by the contractors (Messrs. John Aird and Sons) under the superintendence of the Company's District Engineer; and it had cost about £6000. They felt, however, that they must now lay another main from Putney Bridge to the Putney reservoir; and this would cause a further expenditure of from £7000 to £8000. They did not expect another drought; but it was only right to be prepared for such a contingency. Their neighbourhood kept increasing—not with absolutely new buildings, but with higher ones. Old houses were taken down, and on the sites new ones were run up, nine and ten floors in height, making the work of pumping somewhat difficult. The constant service had been further extended during the half year; and 41 per cent. of their supplies were now being afforded on this system. He thought this was fairly satisfactory. Several Bills had been introduced into Parliament this session affecting the Water Companies' interests. These had received the careful attention of the Directors, and some of the measures had been disposed of altogether. On the whole, he thought that, as far as the Water Companies were concerned, the London County Council (whose animosity towards them was really bitter and unreasonable) had not had much luck. That body had had, in fact, one or two "raps," which he hoped they would appreciate. They now heard that the report of the Royal Commission on the Metropolitan Water Supply would be issued very soon. He did not know what that meant; it might mean in one month or in six months' time. He wished that something were settled, as it was difficult for them to know what to do in the meantime. The works of the Company were all in splendid condition, and in every way fitted for their work. The increase of rental in the past half year had been £1820, which was very good indeed. It arose very much from large meter supplies, which possibly answered their purpose, on the whole, as well as anything else.

The DEPUTY-GOVERNOR (Mr. F. S. Clayton) seconded the motion, which was at once unanimously carried.

On the motion of the GOVERNOR, seconded by the DEPUTY-GOVERNOR, resolutions were afterwards passed receiving the accounts; authorizing the Directors to set apart out of the profits sufficient to pay the preference dividends; and declaring a dividend for the half year ended March 31 last at the rate of 10 per cent. per annum on the ordinary capital stock, less income-tax, to be paid "to the several persons and corporations who are proprietors of such capital stock, excepting only such of the holders of 4½ per cent. preference convertible stock as have converted their holdings into ordinary stock, and whose right to participate in ordinary stock dividends takes effect from March 31, 1893."

The retiring Directors (Sir W. H. Wyatt, Mr. F. S. Clayton, and Sir Wilford Brett) were afterwards re-elected, as was also the retiring Auditor (Mr. J. A. Hallett).

Mr. WARD then proposed a vote of thanks to the Governor and Directors, for the capable way in which they had managed the affairs of the Company during the past six months, in which they had experienced exceptional difficulties. The drought had now lasted for three months; but they had been able to supply the consumers fully. They read in the newspapers that Manchester now had a supply for only 40 days; that the Mayor of Birmingham had issued a note to all consumers, requesting them to observe the greatest economy in the use of water; that Nantwich had no more water than Manchester; and that Plymouth was in great straits. In these places the control of the water supply was in the hands of the municipal authorities; and he thought that, if some of the ratepayers who advocated the transfer of the undertakings of the London Water Companies to a public body would only read and consider these statements, they would not be in such a hurry for the change, especially in view of the undoubtedly efficient way in which the water supply of the Metropolis was administered at the present time. The Directors deserved the thanks of the proprietors not only for what they had done in the past half year, but for the forethought which they had previously shown in placing the works in such an efficient condition.

Mr. J. B. DOE seconded the motion, and it was adopted.

The GOVERNOR, in reply, stated that it was quite true they had had an anxious time. As the proprietors were aware, little mercy would have been shown towards the Directors if they had had to tell the consumers what so many provincial authorities had had to tell theirs. Somehow, however, the latter appeared to get off very easily. The wants of the consumers in the Chelsea and other districts had been fully supplied; and, so far as their own Company were concerned, he felt pretty sure that provision had been made for many years to come. He thought it probable they might require to have an increase of capital; but it was not necessary for him to say anything more on this subject until the next meeting. The Directors would continue to do in the future what they had done in the past—their utmost to promote the welfare of the undertaking.

The proceedings then terminated.

METROPOLIS WATER SUPPLY.

The Quality of the Water in the Month of May.

The returns furnished to the Registrar-General by the London Water Companies as to the water supply of the Metropolis during the month of May show that the average daily supply was 207,617,049 gallons, as compared with 188,458,526 gallons in the corresponding month of 1892. The number of services being 794,555, the rate was 261 gallons per service. Of the entire bulk of water sent out 105,185,388 gallons were drawn from the Thames, and 102,431,661 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: "Taking the average amount of organic impurity in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·8; East London (deep well), 1·1; Tottenham and New River, 1·2; Colne Valley, 1·4; East London (river supply), 1·8 West Middlesex, 2·1; Chelsea, 2·2; Grand Junction, 2·3; and South wark and Lambeth, 2·4. The unfiltered river waters contained the following proportions: New River cut, 1·6; East London Company's intake, 1·8; and the Thames at Hampton, 3·1. The Thames at Hampton was, on May 16, pale yellow and turbid. It was, for river water, of very good chemical quality; but bacterially of medium quality only. Contrasted with the unfiltered water, the supplies of the five Companies drawing from the Thames showed considerable chemical, and the following percentage bacterial improvement: Chelsea, 99·22; West Middlesex, 98·44; Southwark, (No. 2 filter) 99·32, (No. 4 filter) 99·22, (No. 6 filter) 93·47, gravel water 84·2; Grand Junction, (Hampton filters) 98·32, (Kew main filter well) 97·08; and Lambeth, 98·02. The water was in all cases efficiently filtered. The unfiltered water taken chiefly from the Lea by the New River Company on May 18 was turbid and very pale yellow. It was of better chemical, but of worse bacterial quality than on April 7. It was improved bacterially to the extent of 99·39 per cent., and was efficiently filtered. As delivered to consumers, it was chemically equal to deep-well water, and was bacterially the best of the river-derived supplies. The raw water taken from the Lea by the East London Company on May 18 was turbid and very pale yellow. It was chemically better, but bacterially worse in quality than on April 7. By storeage alone, the bacterial impurity was reduced by 73·64 per cent.; and by storeage and filtration combined, by 97·77 per cent. The water was efficiently filtered before delivery, and was then chemically fit to be classed with the deep-well waters. The deep-well waters of the Kent, Colne Valley, and East London Companies and of the Tottenham Local Board of Health were of most excellent quality for dietetic purposes; the Kent and East London Companies' water being especially distinguished by their very high degree of organic purity. The Tottenham water was slightly turbid; but the remaining waters were clear and transparent without filtration. The water of the Colne Valley Company was softened before delivery, and thus rendered suitable for washing. Seen through a stratum 2 feet deep, the Kent, Colne Valley, and East London (deep well) waters were clear and colourless; the Tottenham, colourless and slightly turbid; the New River and East London (river supply), clear and nearly colourless; and the remaining waters clear and very pale yellow. The bacteriological examination, by Dr. Koch's process, of the raw river and gravel waters and of those supplied by the various Companies, collected on the 16th, 17th, 18th, and 19th of May, gave the results contained in the following table:—

	No. of Microbe Colonies per Cubic Centimetre.	Temperature in Deg. C.
Raw River Waters.		
Thames at Hampton	2052	17·6
New River Cut	1973	15·8
Lea at Angel Road	3145	17·3
„ after storeage	829	17·0
River Supplies.		
Chelsea	16	16·8
West Middlesex	32	16·4
Southwark, No. 2 Well	14	15·8
„ No. 4 „	16	16·6
„ No. 6 „	134	16·7
„ gravel water	320	14·3
Grand Junction, Hampton filters	34	17·3
„ „ Kew „	60	17·0
Lambeth	40	17·2
New River	12	17·2
East London, Essex Well, No. 1	70	16·5
Deep Well.		
Kent	4	11·5

Thus, the deep-well water of the Kent Company, as it issues from the pumping-shaft, contained the smallest number of microbes; while of the river-derived supplies, the New River, Southwark, and Chelsea Companies delivered the most highly sterilized water."

In the course of their report for the past month to the Official Water Examiner (General A. de Courcy Scott, R.A.), Messrs. Crookes and Odling say: "The character of the water supply to the Metropolis during the month of May continued to be in all respects entirely satisfactory. The proportion of organic matter present, as indicated by the estimations of organic carbon, of oxygen required for oxidation, and of the colour tint of the water, was exceedingly minute; the mean results of these estimations, in the case, for example, of the Thames-derived samples, being identical with those afforded by the previous month's supply, already commented on for their exceptional lowness, as shown in the following table:—

1893.	Ratio of Brown to Blue Tint. Means.	Oxygen required for Oxidation. Means.	Organic Carbon per 100,000. Means.	Organic Carbon per 100,000. Maxima.
April	11·9 : 20	0·28	0·088	0·125
May	11·3 : 20	0·29	0·089	0·124

No appreciable difference was noticeable in respect to the proportion of common salt—about 1½ grains per gallon—present in the water in flood time and during the present dry period; but, as shown in the following table of Thames water results, the proportions of oxidized nitrogen and the degree of hardness underwent during the later months, probably from the increasing activity of fluviatile vegetation, a steady and appreciable decrease:—

1893.	Common Salt per 100,000.	Nitric Acid per 100,000.	Degrees of Hardness per Gallon.
February	2·242	0·952	17·56
March	2·167	0·931	16·80
April	2·181	0·888	15·11
May	2·196	0·611	14·66

All of the 182 samples examined during the month were found to be clear, bright, and efficiently filtered."

Unsupported Electric Light Undertakings.—The Board of Trade have revoked the St. Luke's (Chelsea) Electric Lighting Order, 1891; and the project which was some time ago set on foot to light Redruth by electricity has been abandoned owing to want of public support.

WATER SUPPLIES AND THE DROUGHT.

The severe drought of the past three months, which has been a source of dismay throughout the country, has led to official statements being made during the last few days as to the position of the water supplies of various cities and towns. At Liverpool, it appears, there is no cause for alarm, as, according to some remarks made by the Chairman (Alderman T. Hughes) at the meeting of the Water Committee on Tuesday, they have at Vyrnwy alone about 18 months' supply, even if there should not be a drop of rain for that period. This is a very satisfactory state of things; seeing that other places are also deriving a supply from the Vyrnwy aqueduct. For instance, Oswestry is being furnished with 250,000 gallons per day. At Manchester, Sir John Harwood, the Chairman of the Water Committee, announced last Wednesday that they are in possession of between 40 and 45 days' supply of what may be called "fairly good water." They have more than this; but it cannot be considered of a satisfactory quality. He thinks that, if it becomes a matter of necessity, they may obtain some assistance from the Liverpool Corporation; but it would be from the Rivington reservoirs. A small supply, adequate for domestic purposes, can also be procured from Thirlmere, if no rain falls within the next 50 or 60 days. Each evening, since last Sunday week, the water has been turned off at the mains until five o'clock in the morning; and it is estimated that nearly 3 million gallons per day have been saved by this means. In Birmingham, the public appear to have paid very little heed to the warning recently issued by the Mayor (see *ante*, p. 1085) respecting the consumption of water. Accordingly, the Water Committee have announced that, unless a marked diminution takes place within the next few days, the supply will be reduced. At present there is no prospect of a water famine; but, in view of the prolonged drought, the authorities consider themselves justified in taking reasonable precautions to avert any danger of such a contingency. From Bradford we learnt last week that the low-level supply would last about 100 days, and the high-level about 40 days; while Huddersfield could only boast of 65 days' supply. The Ashton-under-Lyne, Stalybridge, and District Joint Water Committee have decided to secure the necessary plant for pumping water from the compensation reservoir, which is at low level, into one of the service reservoirs, from which the mains can be filled. If this can be done, the water supply to 200,000 inhabitants will be increased by three weeks. At Halifax, the Corporation supply, though at present ample, is decreasing at a rapid rate. Last Thursday, the aggregate storeage in the various reservoirs was 731,090,000 gallons; being a decrease, as compared with the quantity in store at the corresponding period of last year, of 419,640,000 gallons. Baildon and Batley are in a bad position; having only a visible supply for about a fortnight. At Heckmondwike, Leicester, Preston, Thirsk, and Wigan, the inhabitants have been requested to use the water sparingly. It is reported that in many rural districts in Kent, Surrey, and Sussex, there is such a scarcity of water that it can be only obtained at famine prices—as much as 3d. a pailful being charged in several cases. From North Wales, we learn that Llandudno has a good stock of water in store; but Llyn Cowlyd, which is in the same water district as Colwyn Bay and Conway, is reported to be getting low. Carnarvon is reaping the benefits of the precautions adopted a few years ago for securing an independent source, as is also Bangor. Serious reports as to defective supplies of water come from Menai Bridge, Port Dinorwie, Nantlle, and other districts. At Plymouth, as mentioned in the JOURNAL a fortnight ago, the townspeople have been suffering from a curtailment of the water supply; and in view of this fact, arrangements are being made for carrying out the Burrator scheme, which has lately been sanctioned by Parliament. Its completion will necessarily occupy some time; but it will in all probability prevent a repetition of the present difficulty. There were downfalls of rain in several parts of the country during the past week; but they did not make any appreciable difference in the available supplies of water.

The St. Helens Gas Undertaking.—With reference to the report, in the last number of the JOURNAL, as to the working of the St. Helens Corporation gas undertaking in the past financial year, the unaccounted-for gas should have been given as 4·97 per cent. It may be mentioned that the make of gas for the same period amounted to 225 million cubic feet; being an increase of 11 millions on the production in the year ending March 31, 1892.

The Frimley and Farnborough District Water Bill.—An extraordinary meeting of the Woking Water and Gas Company was held last Tuesday for the purpose of approving of the above Bill. Explanations were made to the shareholders by the Chairman (Mr. C. Horsley), Mr. R. Hesketh Jones, and the Solicitor (Mr. C. A. Bannister), to the effect that some four or five years ago the Company acquired the right, under the Surrey and Hants District Water Act, 1887, to supply the Frimley and Farnborough district with water; but it afterwards appeared that the inhabitants were not in a position to guarantee a certain amount of rental to justify them in carrying out the necessary works. Last year the promoters of the Bill introduced a similar measure, which the Company successfully opposed; but, after several conferences between the Directors and the promoters, the present Bill was lodged. In consideration for transferring the district to the new Company, the Woking Company are to receive fully-paid-up shares to the nominal amount of £5000; but no dividend is to be payable thereon until a dividend of 5 per cent. per annum has been paid upon the other share capital issued to the amount of £25,000. The promoters are to pay all the costs of the Company, who secure the right to raise a little more by debentures, and are to be indemnified for having issued a certain amount of capital under the Surrey and Hants Act. The Bill authorizes the Aldershot Gas and Water Company, the Woking Company, and the Wokingham District Water Company to enter into agreements to supply the new Company with water in bulk, and to purchase their undertaking. It was considered by the meeting that, under the circumstances, the terms were satisfactory; and the Bill was accordingly approved.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Dundee bulks largest in my budget this week, because I have to deal with the annual meeting of the Gas Commission, at which the accounts for the year were presented. These were in all respects satisfactory; and the Commission are to be congratulated upon their working for the year. That they have been able to wipe out a deficit of £4780, and to end with a balance on the right side of £253, is a matter which can only be subject of gratification—especially when it is mentioned that the surplus is largely owing to the increased yield of gas from the coal, which, though estimated to produce 10,000 cubic feet per ton, actually produced 10,021 feet per ton. This is the first time the Commissioners have experienced an agreeable surprise of this description, at least within my knowledge of their doings. There is another gratifying feature; and that is that the unaccounted-for gas has been reduced from 10 to 8½ per cent. These items are both in the technical department of the undertaking; and the credit for the improvement which has been effected must, in the first instance, be ascribed to the sound advice as to the purchase of coal given by the Manager (Mr. J. M'Crae) and to his careful working during the year. Without this, the balance might easily have been on the other side. In this connection, it is noticeable that the Commissioners have adopted the policy of not placing any reliance upon the analyses of coal-owners. They now proceed only upon the results of their own tests and laboratory analyses, which is exactly the advice given by Mr. M'Crae, in his paper on "Coal Analysis," before the North British Association last year. Then it is to be noticed that on the financial side circumstances favoured the Commissioners. Their supply of coal for the first seven months cost them about 16s. per ton; and when the remainder was contracted for, it was got at a reduction of about 2s. per ton. Had they paid under the second contract as much as they did under the first, their expenditure would have been £40,000; and as the actual expenditure was only £38,605, there was thus a saving of £1400, which more than accounts for the surplus that was realized. The Commissioners were also fortunate in having an increased sale of nearly 6 million cubic feet of gas, which was the more unexpected as the price was increased by 1d. per 1000 cubic feet last year. This shows a healthy state of affairs in the city, notwithstanding all that is said about dull trade and mills working short time. With the advantageous terms they have secured for coal, and the rise in the price of sulphate of ammonia which they are experiencing, the Commissioners have the best augury for a good year, although they are now competing with their own electric lighting installation. Upon this subject, Mr. Mitchell, the Convener of the Finance Committee, who submitted the accounts, was very reticent. The time has not come when a yearly balance-sheet can be made up; and all that he could express regarding the department was the hope that "it would not entail a very heavy loss to be borne by gas consumers, but that in a few years it would be self-supporting, if not profitable." He does not seem to expect that it will be even self-supporting, which, when the low price charged—5d. per unit—is considered, is the reasonable view to hold. The questionable nature of their policy of offering an article at less than cost price in order to induce purchasers, might begin to dawn upon the Commissioners, because if, after establishing a business, they should find it necessary to raise the price to (say) 7d. per unit, how many of their customers would remain? There is one other satisfactory feature in the gas accounts which should be noticed. It is that the contingent fund is being again increased; the full sum required by Act of Parliament having this year been placed to it.

At a meeting of the Gourock Police Commissioners on Tuesday, it was reported that the revenue of the Gas Department during the past year was £2867; and the expenditure, £2385—leaving a gross surplus of £482. After, however, providing for interest and capital charges, there was a deficit on the year of £51, all of which was accounted for by the falling off in the return for residuals.

The Corporation of Kirkintilloch have remitted to the Gas Committee to consider the subject of the enrichment of coal gas by means of oil. Kirkintilloch is the original home of the Alexander-Paterson oil-gas process; and, though no particular plant was mentioned, no doubt the claims of that system will be carefully considered. At Kilsyth, the Gas Commissioners have employed Mr. Dennis, of Dalkeith, to advise them on the subject of enrichment by oil; and his advice is that the process can be introduced without extending the gas-works. The process in this instance is the one employed at Peebles.

A year ago, at the annual meeting of Young's Paraffin Light and Mineral Oil Company, Sir James King, the Chairman, spoke hopefully of the oil trade in respect of the spread of oil-gas lighting in railway trains; and also, though he put it subsidiarily, on account of the fact that gas managers were turning their attention to oil, so as to increase the illuminating power of the gas obtained from lower-priced coal. Sir James did not speak without book. Long before he made the statement, he was aware of the experiments which Mr. W. Young, of Peebles, was making with his plant. At this year's meeting of the Company, held on Monday, Sir James King again presided; and in his address to the shareholders, he recalled his statement of last year. He said that since then "the Peebles oil-gas process, which was at that time only in the experimental stage, had already developed into a marked practical success. It was automatic in its action, economical in its results, and yielded a gas which was pure and permanent. The effect of this upon the Scotch industry could not but be beneficial, in absorbing a class of oils often difficult to sell." This is not the only statement of interest in Sir James King's speech. "They had," he said, "lessened the cost of production, which amounted in the whole to £72,000, by £30,000 during the year. When the Company started, the cost of the finished product was 1s. 3d. a gallon; and during the past six months it averaged about 4d. a gallon. This had been attained by improved retorts, refrigerators, stills, and inventions generally, by means of which there was really more being taken out of the shale than it was at one time supposed to contain." The same downward course in the cost of production has, of course, been experienced in gas-works. It is extremely satisfactory to see a sister industry being able to improve its position in the market; and at the same time,

Sir James King's remarks show how little reason there is to fear, as some gas engineers do, that a general use of oil-enriching processes would lead to the price of oil being raised, so as to take away any advantage there might be in using such systems.

The sulphate of ammonia market is still improving. This week the prices quoted, f.o.b. at Leith, are £12 15s. per ton spot, and £12 2s. 6d. for delivery between October and March.

An excellent testimony to the value of a system of checking waste of water, where the authorities are lax in looking after the supply, has been furnished in Aberdeen. In a report by the Burgh Surveyor on the working of Deacon meters, which have been in use for some time, it was stated that the diagrams showed the supply in one district to be at the rate of 95·6 gallons per head of the population per day, and the waste to be 70·2 gallons. In one district, the waste was going on at the rate of 1500 gallons per hour. After the execution of repairs, the supply has been brought down to 56·6 gallons—a saving, roughly speaking, of 40 gallons per head per day over all the districts metered—without the issue of a single order to any proprietor to renew fittings which were in exceptionally bad order. The Surveyor believed that, had repairs been required upon fittings, the saving would have been still greater. When the report came before the Water Committee of the Town Council, they recommended that the whole of the city should be put under the Deacon meter system, at a cost of £3400; and the Council on Monday, without remark, adopted the recommendation. The Corporation are about to expend £82,000 upon new water-works. These are, however, not intended for the augmentation of the supply so much as for its purification—£60,000 being required for filters and a settling-pond—and the improvement of the distribution.

The Edinburgh and District Water Trustees, who have been considering the subject of augmenting the present supply since 1888, have now reached a point at which it appears as if they would really go forward and do something. There is unanimity among them that it will not be safe to postpone the preparation for an augmented supply any longer, because the population of both Edinburgh and Leith is increasing rapidly. A special meeting of the Trustees was held on Thursday, to consider the recommendation of the Works Committee. Two hours were spent in talk, more than half of which was taken up by speakers who were not prepared to commit themselves right off to any particular scheme. Some of these gentlemen pleaded that they had not been long members of the Trust, and that they were not personally acquainted with the sources of supply which had been mentioned. Lord Provost Russell is one who has not seen all the places which the Trustees have looked at; but he had no scruples, and he moved the adoption of the Manor scheme. He, however, gave way to a proposal by Mr. Colston, that the Trustees should pay an official visit to the districts; and this was agreed to. Now, there is no need to hurry the matter forward for a month or two; but it is desirable that they should be in Parliament next spring asking for powers to introduce the augmented supply. A few weeks' delay will not interfere with that; but a suspicion is abroad that some of those who profess innocent ignorance, are in reality seeking a foundation for resuscitating the St. Mary's Loch scheme, which was rejected 20 years ago. No exception can certainly be taken to anyone who honestly believes that the St. Mary's Loch scheme is the best bringing it forward and advocating it, provided that all act loyally when the vote is taken, and allow the Trustees to go to Parliament with an unbroken front. But it will be a pity if the St. Mary's Loch scheme, which is not approved by either the majority of the Trustees or by their Engineers, should be thrust forward to divide the Trust and prevent them getting the parliamentary powers they need. On the merits of the question, all I would say is that the weakest part of the Manor scheme appears to be that it involves the construction of a huge reservoir, the foundations for the embankment of which appear not to be of the best, and which would either lead to an enormous cost, or to very great risk if it were not constructed of sufficient strength. That is a matter, however, for engineers, and not for laymen to decide; and there is just a probability that, by allowing the opposition to look at the place, their opinion may change, and the scheme of the majority be unanimously adopted. If that should be so, the official visit may be profitable in the end.

The copious rainfall of Thursday and Friday of this week has gladdened the heart of the agriculturist. It has also brought relief, though not to the same extent, to water suppliers. Though during 36 hours nearly three inches of rain fell, the ground was in such a parched condition that it absorbed practically all of it as it fell, and left little for the augmentation of the streams. Still, though streams are more rapidly affected by rainfall in these days of almost universal drainage, there is certain to be some which will filter into them; and besides, the drought being once broken, there are likely to be further falls between this and October, which will keep matters going till the winter again replenishes the supplies. The rainfall has not come too soon, as in several places the community were beginning to feel the pinch of scarcity. In Aberdeen, the Dee had fallen so low that the Water Committee early in the week directed that the water should be cut off during the night. At Hawick, it was discovered the other day, on the Police Commissioners visiting the water-works, that there was only a month's supply in store. The Commissioners are about to bring in an augmentation, which will supply the town without stint for a number of years. It is pleasant to turn from these accounts to what is taking place at Arbroath. There the water supply is—an unusual thing in Scotland—an underground one, obtained by pumping. For some months an additional well has been in course of being put down. It has now been found that this well is equal to yielding 225,000 gallons per day, which more than doubles the supply.

Extensions at the Leominster Gas-Works.—The Leominster Gas Company are having extensive alterations and enlargements made at their works, under the advice and direction of Mr. W. Parlby, of Hereford. The improvements consist of two 12-feet purifiers; an 80 ft. by 20 ft. single-lift gasholder, with steel tank; and the rearrangement of the mains and station meter. The whole of the work, including the excavations and the concrete foundations, has been entrusted to Messrs. R. Dempster and Sons, Limited, of Elland. The riveting of the tank is being done by special hydraulic plant upon the site.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 24.

Sulphate of Ammonia.—The excitement is unabated; and there is a further considerable advance in prices. The demand at the present moment seems to have overtaken the supply—dealers and buyers generally vieing with each other in their eagerness to secure the few parcels which have been offered; and it is impossible to predict the limit of value which may be ultimately reached should the existing state of things continue. The principal sales have been for delivery at Leith, where supplies have been rather more plentiful, and £13 has been reached; while for October to March delivery, £12 5s. to £12 7s. 6d. is reported. At Hull and Liverpool, business has been limited, owing to the small quantity available—the value being £12 17s. 6d. to £13; and the market closes with a firm tendency. Nitrate on spot is unchanged at 8s. 6d. to 8s. 9d. There is, however, a better tone in the market for cargoes.

LONDON, *June* 24.

Tar Products.—The very low prices prevailing have at last brought in buyers; and business is reported in benzols at 1s. 6d. to 1s. 7d. for 90's, according to position and delivery, and 1s. 5d. for 50's. There seems little chance of benzols returning to higher figures; but it is refreshing to see that there are buyers even at this low price. It looked a week or two ago as if they were not wanted at any figure. Considerable sales in pitch are also reported, at about 23s. 6d. per ton. There is a better feeling in regard to disinfecting products; and a large business has been done both in carbolic and cresylic for French delivery. There is nothing new in respect to anthracene; but the Tar Products Committee maintain their price. To-day's values are: Tar, 10s. to 12s., according to position. Pitch, 23s. 6d. Benzols, 90's, 1s. 6½d.; 50's, 1s. 5d. Solvent naphtha, 1s. 0½d. Toluol, 1s. 4d. Crude benzol naphtha, 30 per cent., 7½d. Creosote, 1d. Salts, 16s. Carbolic acid, 60's, 2s.; 70's, 2s. 4½d.; crystals, 7d. Cresol, 1s. 10d. Anthracene, nominal, 30 per cent. "A," 1s.; "B," 8d.

Sulphate of Ammonia.—There is great competition among dealers for any parcels offering; and a further advance has taken place during the week. Sellers are asking £13 5s.; and buyers have bid £13 2s. 6d. Business has been done during the week at prices between £12 15s. and £13, less 3¼ per cent. Gas liquor is quoted at 8s. 6d. to 9s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The gas coal contracts are being gradually settled; but nothing definite has yet been decided with regard to one or two important ones in this district. So far as the prices have transpired, they fully bear out what has been previously reported, as to the considerable giving way upon the rates last year; the reduction in most cases averaging quite 1s. to 1s. 6d. per ton. At the pit mouth, common screened gas coals have been bought at from 7s. to 7s. 6d. per ton; while the best Wigan screened gas coals range, according to quality, from about 8s. up to 8s. 9d. per ton. With regard to the general trade, extreme depression continues as far as all descriptions of round coal are concerned, and considerable stocks are accumulating. Prices remain without any actually quotable change; but the tone all through is weak, and sales of anything like quantities are as a rule only effected at special rates. Generally, it may be stated that best Wigan Arley coal is not fetching more than 11s.; Pemberton four-feet and seconds Arley, 8s. 6d. to 9s.; common qualities, 7s. 6d.; and the lower qualities of round coal, 6s. to 6s. 6d. per ton at the pit mouth. The very limited production of slack causes a continued scarcity of engine fuel; but prices, although very firm, show no further material upward movement. At the pit mouth, burgy averages 6s. 3d. to 6s. 9d.; best slack, 5s. 3d. to 5s. 6d.; medium, 4s. 6d. to 4s. 9d.; and common coal, about 4s. to 4s. 3d. per ton.

Northern Coal Trade.—The important feature in the coal trade of the North, is the decision of the miners of Northumberland to enter the Miners' Federation, which now includes all the important English districts. This step will probably have very important results in the autumn; and gas companies would do well to maintain full stocks whilst coal and freights are low. The local holidays lessened the production of coal last week; and thus there has been a rather better demand for all kinds of fuel. Best Northumbrian steam coal is about 8s. 9d.; second qualities, 8s. to 8s. 3d.; and small steam coals, 3s. 6d. to 3s. 9d. per ton f.o.b. The demand for manufacturing coal is very limited; and the price is weak. Gas coal is now very plentiful, and the price is 6s. to 6s. 6d. per ton generally, though one or two collieries ask up to 7s. per ton f.o.b. There are many of the best gas coal collieries, however, which do not yet have orders to keep them employed more than two or three days a week. Coke is in fuller demand, and the price, delivered at the local furnaces, is now 12s. per ton. For shipment, best foundry coke is still quoted from 13s. 6d. to 14s. per ton f.o.b. There is no alteration in gas coke; but the price is rather steadier, the stocks having been reduced in the summer months.

Scotch Coal Trade.—The most notable feature of the coal trade in Scotland this week is the lessening of stocks of coal, consequent upon the persistent policy of four days' working a week, which the miners are pursuing. Prices have shown a slightly upward tendency this week, the quotations being: Main, 5s. 9d. to 6s.; ell, 7s. to 7s. 3d.; splint, 6s. 6d. to 6s. 9d.; and steam, 7s. 9d. to 8s. per ton, f.o.b. Glasgow. The shipments reported for the week were 160,850 tons—a decrease upon the preceding six days of 22,141 tons, and as compared with the corresponding week of last year of 9662 tons. For the year to date, the total shipments have been 2,977,751 tons—a decrease as compared with the corresponding period of last year of 380,278 tons.

Heavy Loss due to the Overturning of a Paraffin Lamp.—At Ipswich last Wednesday a fire, involving damage to the extent of £20,000, occurred at the maltings of Messrs. R. and W. Paul, owing, it is reported, to the accidental upsetting of a paraffin lamp. About 10,000 quarters of malt and barley were destroyed.

New Joint-Stock Companies.—The Salt Lake and Ogden Gas and Electric Light Company, Limited, has been registered with a capital of £300,000, in £1 shares, to carry on, in the United States, England, and elsewhere, and particularly in the territory of Utah, U.S.A., the business of a gas and electric lighting company in all its branches, and of manufacturers of, and dealers in, apparatus and appliances therefor. The Valveless Gas-Engine Syndicate, Limited, with a capital of £15,000, in £10 shares, has been formed to carry into effect agreements made between Messrs. Day and Wright and between Messrs. Easton and Anderson, Limited, J. Day, and the Company, for the acquisition of certain patents relating to gas-engines.

The Gadd and Mason System of Gasholder Construction.—The Widnes Corporation have decided to adopt the Gadd and Mason system in the erection of the new holder, of 700,000 cubic feet capacity, for which a contract has just been placed with Messrs. R. and J. Dempster, of Manchester. It will be 115 feet in diameter, in three lifts, each 24 feet deep. In the designs for the holder, the latest improvement—viz., fixing the spiral guides and carriages externally instead of internally, to facilitate inspection of the working parts—has been adopted. The Sutton-in-Ashfield Gas Company have recently placed an order with the above-named firm for a holder on the Gadd and Mason principle. It will be 72 feet in diameter, in two lifts, each 18 feet deep. It may be mentioned that, in addition to these, there are 25 holders on this system in operation or in course of erection.

The Opposition of Walsall to the South Staffordshire Water Company's Bill.—A Sub-Committee appointed by the Walsall Town Council to deal with their opposition to the South Staffordshire Water Company's Bill have been able to report that they have secured material concessions. The Company have agreed to supply the Corporation with water for public purposes at a rate not exceeding 7½d. per 1000 gallons; to fix the rent for meters used by the Corporation at the rate of 10 per cent. upon the cost of such appliances; to give notice at the head office of the fire brigade whenever it is proposed to shut off the water in any part of the town; and to place stopcocks in future within 15 inches of the front walls of all buildings. Thus, in addition to the amendments which the Committee had previously reported—viz., improved pressure, the reduction of the proposed new capital by £100,000, and the extension of the auction clauses to such capital, &c.—the Corporation have obtained such a reduced rate for public purposes as will soon recoup them for the outlay they have incurred.

Gas v. Electricity for Lighthouse Illumination.—In the House of Commons, on Monday last week, Mr. W. Kenny asked the President of the Board of Trade whether he had received from the Chamber of Commerce of Dublin a document entitled "Evidence respecting the Electric Light as a Lighthouse Illuminant," referring to a trial between that light and Mr. Wigham's new gas-light, proposed to be made by that gentleman at his own expense; whether he would inform the House how the matter stood as to the application of the electric light as a "fixed" light at the Old Head of Kinsale; whether the Board of Trade and the Trinity House had given sanction to this application; and whether, considering the important evidence in the paper above referred to, including reference to the loss of the *Eider* at St. Catherine's Point, and the opinions expressed in a recent parliamentary paper, he would give instructions that nothing further should be done until the trial proposed by Mr. Wigham should have been completed. Mr. Mundella said he had received the document referred to, which he presumed had also been sent to the Commissioners of Irish Lights, with whom would rest the decision whether in this instance experiments which did not involve the expenditure of public money should be carried out. In March, 1891, the Commissioners applied to the Trinity House for the requisite sanction to the establishment of a fixed electric light at the Old Head of Kinsale; and the Trinity House declined to give their statutory approval—a course which was concurred in by the Board of Trade.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1207.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share.	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	**GAS COMPANIES.**				£ s. d.
590,000	10	13 Apl.	10½	Alliance & Dublin 10 p. c.	10	15½—17½	..	6 0 0
100,000	10	,,	7½	Do. 7 p. c.	10	11½—12½	..	6 0 0
300,000	100	3 Jan.	5	Australian (Sydney) 5 % Deb.	100	104—105	..	4 14 2
100,000	20	31 May	8	Bahia, Limited	20	10½—11½	..	13 18 3
200,000	5	12 May	6½	Bombay, Limited	5	5½—6	..	5 8 4
40,000	5	,,	6½	Do. New	4	3¾—4¼	..	6 2 6
380,000	Stck.	24 Feb.	11½	Brentford Consolidated	100	220—225	+3	5 2 2
180,000	,,	,,	8½	Do. New	100	168—173	..	4 18 3
220,000	20	15 Mar.	11½	Brighton & Hove Original	20	41—43	..	5 6 11
888,500	Stck.	31 Aug.	5	Bristol	100	104—107	..	4 13 5
320,000	20	13 Apl.	11½	British	20	43—44	+½	5 4 7
50,000	10	15 Mar.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	15—16	+½	5 6 3
328,750	10	—	—	Buenos Ayres (New) Limited	10	6–7	..	—
200,000	100	3 Jan.	6	Do. 6 p. c. Deb.	100	100–103	+1½	5 16 7
150,000	20	24 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	28 Apl.	12½	Commercial, Old Stock	100	215—250	+1	5 0 0
165,000	,,	,,	9½	Do. New do.	100	182—187	..	5 1 7
163,762	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	125–130*	..	3 9 3
800,000	Stck.	15 June	13	Continental Union, Limited	100	227–232*	..	5 12 0
200,000	,,	,,	10	Do. 7 p. c. Pref	100	190–195*	..	5 2 7
75,000	Stck.	15 Mar.	10	Crystal Palace District	100	190—195	+3	5 2 7
486,090	10	27 Jan.	10	European, Limited	10	22—23	+½	4 6 11
354,060	10	,,	10	Do. Partly paid	7½	15—10	..	4 13 9
5,596,560	Stck.	10 Feb.	12	Gaslight & Coke, A, Ordinary	100	225—230	+2	5 4 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	95—99	..	4 0 10
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	263—268	..	3 14 7
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	120—125	..	4 0 0
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	170—175	..	4 5 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	170—175	+1	4 0 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	262—267	..	3 14 10
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	156—160	..	3 15 0
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	125—128	..	3 2 6
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	128–132*	..	3 8 2
908,000	,,	,,	6	Do. 6 p. c. do	100	167–172*	..	3 9 9
3,800,000	Stck.	12 May	12	Imperial Continental	100	225—230	+1	5 4 3
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	5–5½*	..	5 9 1
560,000	100	4 Apl.	5	Met. of Melbourne, 5p. c. Deb.	100	103—105	..	4 15 3
541,920	20	15 June	5	Monte Video, Limited	20	13—14*	..	7 2 10
150,000	5	31 May	10	Oriental, Limited	5	7½—8	..	6 5 0
60,000	5	29 Mar.	7	Ottoman, Limited	5	4¼—4⅝	..	7 3 8
166,870	10	—	2	Pará Limited	10	2—2½	+¼	—
				People's Gas of Chicago—				
420,000	100	2 May	6	1st Mtg. Bds.	100	100—105	..	5 14 3
500,000	100	1 June	6	2nd Do.	100	98—102	..	5 17 8
150,000	10	28 Apl.	5	San Paulo, Limited	10	8½—9½	..	5 5 3
500,000	Stck.	24 Feb.	15½	South Metropolitan, A Stock	100	294—299	..	5 3 8
1,350,000	,,	,,	12	Do. B do.	100	244—248	..	4 16 9
230,000	,,	,,	13	Do. C do.	100	250—255	..	5 1 11
750,000	,,	13 Jan.	5	Do. 5 p. c. Deb. Stk.	100	148—152	..	3 5 9
60,000	Stck.	15 Mar.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
744,897	Stck.	30 Dec.	10	Chelsea, Ordinary	100	262—267	..	3 14 11
1,720,252	Stck.	29 Mar.	8	East London, Ordinary	100	207—212	..	3 15 4
544,440	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	142—145	..	3 2 1
700,000	50	15 June	8½	Grand Junction	50	107–110*	..	3 17 2
708,000	Stck.	10 Feb.	11	Kent	100	280—285	+2	3 17 2
1,043,800	100	30 Dec.	9½	Lambeth, 10 p. c. max.	100	237—242	..	3 18 6
406,200	100	,,	7½	Do. 7½ p. c. max.	100	199—204	..	3 14 0
310,000	Stck.	29 Mar.	4	Do. 4 p. c. Deb. Stk.	100	129—132	..	3 0 7
500,000	100	10 Feb.	12½	New River, New Shares	100	329—334	..	3 12 8
1,020,000	Stck.	27 Jan.	4	Do. 4 p. c. Deb. Stk	100	133—137	..	2 18 5
902,300	Stck.	15 June	6	S'thwk & V'xhall, 10 p. c. max.	100	147–152*	..	3 18 10
126,500	100	,,	6	Do. D 7½ p. c. do.	100	140–145*	..	4 2 9
1,155,066	Stck.	15 June	10	West Middlesex	100	253–258*	..	3 17 6

*Ex Div.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM LONDON." **GWYNNE & CO.,** TELEPHONE No. 2698.

HYDRAULIC AND GAS ENGINEERS, BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

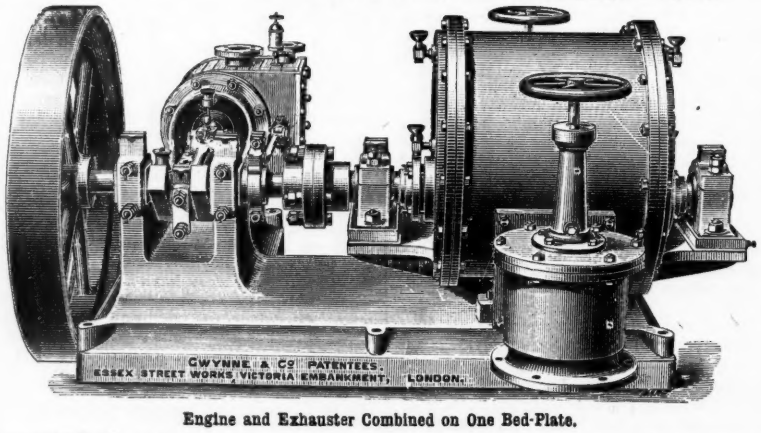
Late Essex Street Works, Victoria Embankment, London, W.C.

Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co., for Gas Exhausters, &c.

They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality.

The result is that in every instance their work is giving the fullest satisfaction.

They have completed Exhausters to the extent of 30,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work, and can be referred to.



Engine and Exhauster Combined on One Bed-Plate.

GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

Catalogues and Testimonials sent on Application.

Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

NO OTHER MAKER CAN DO THIS.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; PATENT SELF SEALING AND CLEANSING RETORT-LIDS AND MOUTHPIECES; CENTRIFUGAL PUMPS and PUMPING ENGINES specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

VOLCANIC Fire Cement (Winkelmann's)
Fire Resistance 4500° Fahr.
ANDREW STEPHENSON, Sole Agent, 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEAR DALKEITH, }

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

WANTED, a Situation as Manager of a Tar Distillery, at either a Gas-Works or Private Yard. Advertiser has a thorough practical knowledge of every branch of Tar Distilling and Ammonia Making. Could undertake erection of a new Plant.
Address J. LIGHTFOOT, 3, Christ Church Terrace, ACCRINGTON.

HOLIDAYS.

GAS Engineer, thoroughly practical, is open to an ENGAGEMENT, and would undertake charge of large or medium-sized Works during absence of Engineer. Security and highest references.
Address No. 2245, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, first-class Retort Setters.
Regular employment.
Apply, with full particulars of age, where last employed, and whether Society or Non-Society, to No. 2251, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ASSISTANT.

WANTED, by a Gas Company, an ASSISTANT to the Engineer at the Works. Must be a good Draughtsman and Surveyor, and understand the Purification of Gas. A married Man preferred, about 35 years of age.
Salary to commence, £200 per annum.
Apply, by letter, to No. 2249, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

BRAZILS.

TO MANUFACTURERS AND OTHERS.

CONTINENTAL Firm of standing, with several Branch Houses in the Brazils, is open to make arrangements with Manufacturers and others, either as MERCHANTS, AGENTS or EXCLUSIVE BUYERS.
Payments could be made in Europe.
First-rate English references given and asked.
Address, by letter, "HILD," care of Bates, Hendy, and Co., 37, Walbrook, LONDON, E.C.

WANTED, a good second-hand Livesey WASHER, to pass 45,000 feet of Gas per hour.
Apply, by letter, stating full particulars, to No. 2253, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Gasholder and Cast-Iron TANK, 5000 to 8000 cubic feet, second-hand in sound condition, or new.
State all Particulars and lowest Price, including Carriage and erecting and leaving in working order, within 30 miles of London.
Address No. 2252, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO BE SOLD—Four 14 feet Square PURIFIERS, with Tee-Bars, Stands, and four Tiers of Wood Sieves to each, complete with Wrought-Iron Covers, Air-Plugs, Test-Cocks, Fasteners, also suitable Lifting Apparatus, delivered and erected for the sum of £250 net. Removed to make room for a larger size.
Apply to W. C. HOLMES AND CO., Gas Engineers and Contractors, HUDDERSFIELD.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield; AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. IV., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

TO INVENTORS AND OTHERS.

PATENTS for Inventions Secured and TRADE MARKS REGISTERED throughout the World. Advice on all matters connected with the above. Handbook gratis on application.
J. C. CHAPMAN, C.E., Chartered Patent Agent, 70, Chancery Lane, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works sundries.
Telegrams: "HUTCHINSON BROS., BARNSLEY."

RAILWAY TANK-WAGGONS.

THE Advertiser is prepared to Sell or LET ON HIRE two RAILWAY TANK-WAGGONS, nearly new. Suitable for Tar or Gas Water, &c.
Address No. 2237, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO BE SOLD, cheap—A Counter- balanced GASHOLDER, 34 feet diameter by 11 feet deep, in a Cast-Iron Tank, lying now at the Leominster Gas-Works. All in good condition.
Please communicate with No. 2250, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Purifier-Valve (Four-way), 6-inch, by Cockey, Frome. In good condition.
METERS, second-hand, two and three light; surplus stock.
Apply to the SECRETARY, Gas Company, Solihull, WARWICKSHIRE.

FOR SALE—Two Lengths of Cast-Iron HYDRAULIC MAIN, ⊂-shaped, 6 ft. 3 in. long, by 14 in. by 14 in.
Eight H and DIP PIPES, and eight ASCENSION PIPES.
Eight MOUTHPIECES (⊂-shaped), with Cross-Bar, &c., complete, suitable for two Beds of Threes, or for a bed of Threes and Fives.
For Particulars, apply to G. MOAT, Gas-Works, Purston, PONTEFRACT.

SPECIAL BARGAIN.

FOR SALE—Two perfectly new Cast- Iron SCRUBBERS, 10 feet diameter by 50 feet high, with Wrought-Iron Domes, Cast-Iron Spiral Staircase, &c., complete. All plates machine planed. One or both Scrubbers will be sold to suit purchasers.
A perfectly new 30,000 per hour HORIZONTAL DOUBLE PUMP RECIPROCATING EXHAUSTER, with Steam-Engine, with Connections and Valves.
One Second-hand (thoroughly overhauled) VERTICAL PUMP EXHAUSTER, with Steam-Engine (with clean Water and Liquor Pumps attached), to pass 7000 cubic feet of Gas per hour.
One Second-hand (thoroughly overhauled) ROTARY EXHAUSTER, to pass 7000 cubic feet per hour (without Engine), fitted with Pulleys.
The whole of the above Plant can be inspected, and full particulars with prices will be sent, on application to No. 2241, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

RUSHDEN AND HIGHAM FERRERS DISTRICT GAS COMPANY, LIMITED.

REMAINDER OF PLANT FOR SALE.
SITE MUST BE CLEARED. NO REASONABLE OFFER REFUSED.

ONE Two-Lift Gasholder, new in 1888.
Makers, R. and J. Dempster. Outer lift, 35 ft. by 15 ft.; inner do., 33 ft. 6 in. by 15 ft.
One Single GASHOLDER, 30 ft. by 12 ft., thoroughly overhauled in 1887 by Messrs. R. and J. Dempster (New Columns, and Guide-Framing).
The above are in excellent condition and well worth the attention of any persons requiring Gasholders of the above capacity.
For particulars and permission to view, apply to JNO. T. LEWIS, Gas-Works, WELLINGBOROUGH.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

LIQUOR, Tar, and Spent Oxide wanted.
BROTHERTON AND CO., Ammonia and Tar Distillers, BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; 10, Marsden Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA, SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

EXHAUSTER (Rotary), perfectly New (Makers, Dempster and Sons), 20,000 cubic feet per hour, ON SALE, cheap.
Apply to T. G. MARSH, 41, Corporation Street, MANCHESTER.

PURIFIERS.

FOR SALE—A set of Four Purifiers, each 5 feet square, with Grids, &c., lying at the Filey Gas-Works.
For Price and Particulars, apply to HENRY TOBEY, Gas-Works, Malton, YORKS.

GASHOLDER FOR SALE—PURIFIER WANTED.

THE St. Helens Corporation Gas Com- mittee have FOR SALE a TELESCOPIC GASHOLDER, Two Lifts, 20 feet each and 70 feet diameter. Working capacity, about 130,000 cubic feet. Complete with four duplicate Cast-Iron Guide-Columns and Girders. Removal for purposes of Extensions.
Any further Information may be obtained from the undersigned.
Wanted, a small second-hand PURIFIER, with Lute and Cover complete. Area, 40 to 50 square feet.
Lowest offers to be sent to me at these Works.
SAMUEL GLOVER,
Engineer and Manager.
Corporation Gas-Works, St. Helens.

NEWARK GAS COMPANY.

TO MANUFACTURING CHEMISTS AND OTHERS.

THE Directors of the above Company are prepared to receive TENDERS for the purchase of the AMMONIACAL LIQUOR produced at their Works for One Year from the 1st day of July, 1893, at per degree Twaddel (temperature 60° Fahr.).
The Liquor to be not less than 5° in strength.
Terms, cash monthly.
Further Particulars can be had on application to the undersigned, to whom sealed tenders, marked on the outside "Tender for Liquor," are to be sent on or before the 28th inst.
The highest tender will not necessarily be accepted.
By order,
FREDK. B. FOOTTIT,
Secretary.
Newark, June 12, 1893.

NEWARK GAS COMPANY.

TO TAR DISTILLERS AND OTHERS.

THE Directors of the Newark Gas Com- pany are prepared to receive TENDERS for the purchase of the surplus TAR produced at their Works for One Year from the 1st day of July, 1893.
Terms, Cash monthly.
Further Particulars can be obtained on application to the undersigned, to whom sealed tenders are to be sent on or before the 28th inst., marked on the outside "Tender for Tar."
The Directors do not bind themselves to accept the highest or any tender.
By order,
FREDK. B. FOOTTIT,
Secretary.
Newark, June 12, 1893.

AMMONIACAL Liquor Wanted (20,000 gallons per week), delivered at Micklefield Station, N.E. Railway.
Address offers to the MICKLEFIELD COAL AND LIME COMPANY, Wortley, LEEDS.

GAS COAL.

THE Directors of the Oakham Gas Company, Limited, invite TENDERS for about 750 tons of good GAS COAL.
For Particulars and Forms of Tender, apply to
JAS. MASON,
Manager.
June 17, 1893.

TENDERS for the Lighting by Gas or ELECTRICITY of the CITY OF BELEM, the Capital of Gram Pará, Brazil, BY CONTRACT.
The Conditions of Contract and all Particulars may be had on application to the BRAZILIAN CONSULATE, at 6, Great Winchester Street, LONDON, E.C., or at the CONSULATES of LIVERPOOL and GLASGOW.

TENTERDEN GAS AND COKE COMPANY.

THE above Company invite Tenders for 400 tons of good GAS COAL, to be delivered at Headcorn or Appledore Station, S.E.R. 200 tons to be delivered in August, and the remainder as required.
Sealed tenders to be sent to the Secretary on or before the 14th of July next.
June 24, 1893.

THE East Dereham Local Board are prepared to receive TENDERS for the supply of about 1200 tons of screened GAS COAL for the ensuing Year.
Conditions and Forms of Tender to be obtained of the undersigned.
Tenders to be sent in by the 4th of July, 1893.
B. H. VORES,
Clerk to the Local Board.
East Dereham,
June 20, 1893.

THE Selby Local Board of Health invite TENDERS for the supply of about 2000 tons of best screened GAS COAL for One Year, commencing the 1st of August next, delivered at the Gas-Works Siding, Selby.
For further Particulars and Forms of Tender, apply to the undersigned, to whom sealed and endorsed tenders must be sent on or before July 5, 1893.
J. S. NAYLOR,
Manager.
Gas-Works, Selby.

THE Haworth Local Board of Health are prepared to receive TENDERS for the supply of 1800 tons of screened and unscreened GAS COAL, to be delivered (in such quantities as the Board may determine) on Rails at the Haworth Railway Station within the ensuing Twelve Months.
Tenders to be forwarded to me, the undersigned, marked "Coal Tender," on or before the 29th inst.
WM. ROBERTSHAW,
Clerk.
5, Temple Street, Keighley,
June 10, 1893.

TENDERS FOR COAL.

THE Eccleshill and Bolton Gas Com- pany invite TENDERS for 2000 tons of GAS COAL, to be delivered at the Railway Station (G.N.R.) in Twelve Months, in such quantities from time to time as may be required.
Endorsed tenders must reach me not later than Monday morning, the 3rd prox.
J. MELLOR,
Secretary.
Eccleshill, Bradford,
June 14, 1893.

HALIFAX CORPORATION GAS-WORKS.

THE Halifax Corporation are prepared to receive TENDERS (*a*) for the supply of SULPHURIC ACID and OXIDE OF IRON, and (*b*) for the purchase of SPENT OXIDE OF IRON for the Year ending the 30th of June, 1894.
Full Particulars and Forms of Tender may be obtained on application to Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.
Sealed tenders, endorsed "Sulphuric Acid," "Oxide of Iron," or "Spent Oxide of Iron," as the case may be, to be delivered to the undersigned not later than the 6th of July, 1893.
The Corporation do not bind themselves to accept the lowest, highest, or any tender.
KEIGHLEY WALTON,
Town Clerk.

COUNTY BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Hali- fax Corporation are prepared to receive TENDERS for the supply of 50,000 tons of GAS COAL and 10,000 tons of CANNEL COAL, to be supplied in such quantities as may from time to time be determined by the Gas-Works Committee during the Year ending the 31st day of July, 1894.
Forms of Tender and further Information may be obtained on application to Mr. Thomas Holgate, Manager, Gas-Works, Halifax.
Tenders, endorsed "Tender for Coal," must be sent to me on or before the 6th of July, 1893.
The tender of any person paying less than the minimum standard rate of wages, and who does not observe the hours and conditions of labour generally recognized in the district, will not be accepted. This condition shall be construed to the acts of sub-contractors, where such may exist.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
KEIGHLEY WALTON,
Town Clerk.

OSWALDTWISTLE LOCAL BOARD.

THE Gas Committee invite Tenders for the TAR and LIQUOR produced at their Works for One Year from the 31st day of July, 1893.
The quantity of Coal carbonized is over 3500 tons.
Further Particulars may be obtained from the Manager, Gas-Works, Church, near Accrington.
Endorsed tenders to be addressed to me and to be delivered not later than Wednesday, the 19th of July.
WM. SANDEMAN.
Clerk.
Local Board Offices, Oswaldtwistle,
June 13, 1893.

TENDERS FOR COAL.

THE Directors of the Cirencester Gas Company are prepared to receive TENDERS for the supply of from 2000 to 2500 tons of best screened GAS COAL, to be delivered at the Watermoor Station of the Mid and South-Western Junction Railway Company during the Twelve Months ending June 30, 1894.
Tenders, stating whether 20 or 21 cwt. to the ton, to be sent to the undersigned not later than Thursday, June 29 next.
The Directors do not bind themselves to accept the lowest or any tender.
JOHN P. BEECHAM,
Secretary.
Gas Offices: 12, Silver Street, Cirencester,
June 10, 1893.

CROSSGATES GAS COMPANY.

THE Directors of the above Company invite TENDERS for the supply of about 600 to 650 tons of screened GAS COAL and screened GAS NUTS, delivered at the N. E. Railway Siding, Crossgates, in quantities as the Manager may from time to time order.
Tenders to be sent to the Gas Office on or before the 5th of July next.
The Directors do not bind themselves to accept the lowest or any tender.
WM. HIGGINSON,
Manager.
Gas Office, Crossgates, near Leeds.

FIRE-CLAY GOODS.

THE Buxton Local Board invite Tenders for the supply of FIRE-CLAY RETORTS, QUARRIES, BRICKS, and CLAY.
Forms of Tender and Particulars may be obtained of Mr. Smedley, Gas Office, Town Hall, Buxton.
Tenders, endorsed "Tender for Retorts, &c.," addressed to the Chairman of the Gas Committee, to be forwarded not later than noon, on the 8th of July next.
By order,
JOSIAH TAYLOR,
Clerk.
Town Hall, Buxton,
June 23, 1893.

MATLOCK BATH GAS COMPANY, LIMITED.

TENDERS FOR TAR AND LIQUOR.

THE Directors of the above Company invite TENDERS for the purchase of the surplus TAR and LIQUOR produced at their Works, for One Year, commencing from the 1st of July next.
Further Particulars to be obtained of Mr. J. Reeds, Matlock Bath.
The Directors do not bind themselves to accept the highest or any tender.
By order,
A. CLARK,
Secretary.
Matlock Bath,
June 24, 1893.

CORPORATION OF WARRINGTON.
(GAS DEPARTMENT.)

TO COLLIERY PROPRIETORS.

THE Gas Committee invite Tenders for the supply and delivery of 3000 tons of CANNEL and 20,000 tons of COAL.
Forms of Tender, with Conditions, can be obtained on application to Mr. W. S. Haddock, Engineer to the Works.
Sealed tenders, endorsed "Tender for Coal and Cannel," must be addressed to the Chairman of the Gas Committee, and sent in not later than the 6th of July next.
FREDK. TAYLOR,
Secretary.
Gas Offices, Warrington,
June 14, 1893.

TENDERS FOR GAS COAL.

THE Gas Committee of the Town Com- missioners of Newry invite TENDERS for the supply of from 3000 to 3600 tons of GAS COAL, to be delivered in such quantities as may be required by the Committee, and delivered free *ex* Ship or Steamer at Albert Basin, Newry, or f.o.b. at their Shipping Port.
The Coal to be fresh wrought, dry, and free from Clench, Pyrites, or other objectionable matter for Gas Making.
The Committee would assist the Contractor by allowing him to deliver about 1200 tons of Coal prior to the 1st of November next.
Further Particulars may be obtained from Mr. A. Gibb, Manager.
Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, and where raised, to be addressed to the Chairman, and delivered to the undersigned not later than Ten a.m., on Friday, the 7th of July next.
The Committee reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.
By order,
R. H. DOHERTY,
Town Clerk.
Commissioners' Offices, Newry,
June 23, 1893.

WELLINGTON (SALOP) COAL AND GASLIGHT COMPANY.

TO COLLIERY PROPRIETORS.

THE Directors of the above Company invite TENDERS for the supply of about 2000 tons of good screened GAS COAL, delivered at their Siding at the Gas-Works, Wellington, during the Year ending June next.
Tenders, endorsed "Tender for Coal," to be sent to he undersigned on or before the 28th inst.
JNO. C. BELTON,
Manager.
Wellington, Salop,
June 16, 1893.

STRATFORD-ON-AVON COPORATION.
(GAS DEPARTMENT).

THE Gas Committee invite Tenders for the supply of from 3000 to 4000 tons of best screened GAS COAL or NUTS, delivered free on Rail on their Siding, Great Western Railway Company, in such quantities as may be required during the ensuing Year ending June 30, 1894.
Further Particulars and Forms of Tender may be obtained upon application to the undersigned.
Tenders to be sent in not later than July 4 next.
The Gas Committee do not bind themselves to accept the lowest or any tender.
By order,
J. S. CRANMER,
Manager and Secretary.
Gas-Works, Stratford-on-Avon,
June 17, 1893.

WALLINGFORD GASLIGHT AND COKE COMPANY, LIMITED.

TENDERS FOR GAS COAL.

THE Wallingford Gaslight and Coke Company, Limited, invite TENDERS for the supply for One Year, from the 12th of August next, of about 900 tons of best screened GAS COAL, to be delivered free, at the Railway Station at Wallingford, in such quantities and at such times as the Company may require.
Payments monthly.
Sealed tenders, endorsed "Tender for Gas Coal," to be delivered on or before the 31st of July next.
The Company do not bind themselves to accept the lowest or any tender.
By order,
JOHN CARTHEW,
Secretary.
Wallingford, June 20, 1893.

TAMWORTH GASLIGHT AND COKE COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Tamworth Gas- light and Coke Company invite TENDERS for the supply of 2000 tons of the best screened GAS COAL, to be delivered during the Year ending June 30, 1894.
Tenders, stating price per ton, delivered free, at the Midland or L. & N.W.Ry. Station, Tamworth, in such quantities as required by the Manager, to be sent to the undersigned, endorsed "Tender for Gas Coal," on or before the 30th of June, 1893, from whom any further information can be obtained.
The Directors do not bind themselves to accept the lowest or any tender.
By order,
W. A. SAPEY,
Manager and Secretary.
Gas-Works, Tamworth,
June 15, 1893.

NEW MILLS LOCAL BOARD.

THE Gas Committee of the New Mills Local Board invite TENDERS for the supply of GAS COAL and CANNEL for the Year ending June 30, 1894.
Estimated quantity of Coal 1300 tons (more or less), and of Cannel 150 tons (more or less), to be delivered, in such quantities as may be required from time to time, at the L. & N.W. or Midland Railway Stations.
Sealed tenders, endorsed "Gas Coal," with Analysis and full Particulars of the Coal offered, to be sent in, addressed to the Chairman of the Local Board, New Mills, on or before July 7, 1893.
Full particulars may be obtained from the undersigned.
The lowest or any tender not necessarily accepted.
EDW. JONES,
Manager.
Gas Office, New Mills, Stockport,
June 13, 1893.

COUNTY BOROUGH OF BRADFORD.

TO COLLIERY PROPRIETORS.

THE Gas and Electricity Supply Com- mittee of the Bradford Corporation are prepared to receive TENDERS for the supply of best GAS COAL, COBBLES, NUTS, and CANNEL, all to be well screened, dressed, and free from Shale and Pyrites, to be delivered at the several Works of the Corporation in the Borough during the period of One Year or of Two Years, commencing on the 1st day of August next, as may be agreed upon.
Forms of Tender, with any further Information required, may be had on application to Mr. Wood, Gas Engineer, Town Hall.
Sealed tenders, endorsed "Tender for Coal," to be delivered to me on or before Thursday, the 29th of June inst.
An assurance must be given by each Contractor that he pays to the workmen employed by him not less than the minimum standard rate of wages.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
W. T. M'GOWEN,
Town Clerk.
Town Hall, Bradford,
June 16, 1893.

BOROUGH OF DONCASTER.

TENDERS FOR COALS.

THE Gas Committee of the Borough of Doncaster are prepared to receive TENDERS for the supply of 14,000 tons of best GAS COALS during a period commencing July next, and terminating June 30, 1894.

Particulars and Tender Forms may be obtained on application to John Athron, Esq., Chairman, or to the undersigned.

Tenders should be sent, under seal, to the Chairman, endorsed "Tender for Coal," not later than Ten a.m., on Tuesday, the 4th of July next.

By order of the Gas Committee, who do not bind themselves to accept the lowest or any tender.

R. BRIDGE,
Engineer.

Gas-Works, Doncaster,
June 22, 1893.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

TENDERS FOR GENERAL STORES.

THE Gas Committee of the Corporation are prepared to receive TENDERS for the following MATERIALS, in such quantities as may be required during the Twelve Months following the acceptance of tenders, viz.—

1. Iron.
2. Tin Sheets, &c.
3. Lead and Composition Pipes, Glass, Pig Lead, &c.
4. Bolts, Nuts, and Rivets, &c.
5. Iron Castings.
6. Brass Meter Taps and Keys.
7. Steam and Gas Tubes and Fittings.
8. Gas-Meters.
9. Paints, &c.
10. Chandlery.
11. Oils, &c.
12. Cotton Waste.
13. India-rubber Sheeting, Rings, &c.
14. Portland and Roman Cement.
15. Timber.
16. Rope, Yarn, &c.
17. Veterinary Attendance.
18. Steel Shovels, &c.
19. Brushes and Besoms.

Forms of Tender and all further Information may be obtained on application to the Engineer, Gas Offices, Bloom Street, Salford.

Sealed tenders, endorsed "Tender for Miscellaneous Goods," together with sample of Goods offered, addressed to the Chairman of the Gas Committee, Town Hall, Salford, must be delivered to me not later than Five p.m., on Thursday, the 6th of July next.

By order,
SAML. BROWN,
Town Clerk.

Town Hall Salford.

CASES FOR BINDING
VOLUMES OF THE "JOURNAL"
(GREEN CLOTH, GILT LETTERED)
Price 2s. each.

THE GASLIGHT AND COKE COMPANY.

NOTICE is hereby given, that the TRANSFER BOOKS of this Company, so far as they relate to CAPITAL STOCKS WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 4th day of July next, and will be RE-OPENED immediately after the Half-Yearly General Meeting of the Company, to be held in the month of August next.

By order,
JOHN W. FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., June 24, 1893.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

*** *The Act extends to Scotland and Ireland.*

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over

400,000 Tons per Annum.

Full particulars on application to
MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

NOTICE OF REMOVAL.

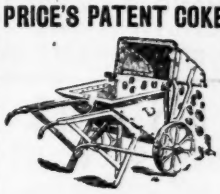
TO GAS ENGINEERS & MANAGERS
CROWTHER BROS.,
Contractors for Retort Setting, Erection of Gas Apparatus, and General Repairs, have removed from 384, Mile End Road, to
152, TEVIOT ST., ST. LEONARD'S ROAD,
POPLAR, LONDON, E.

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in
Efficiency, Economy, Durability, and Easy Working.

PRICE'S PATENT COKE & COAL BARROW



effecting a great saving of time labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee. 22, Alwyne Road, Canonbury LONDON, N.

Prices are Reduced.

To effect a great saving in
GAS-FURNACES use our
Special Derbyshire GANNISTER BRICKS.
ADDRESS
JAMES WHITE & Co., Limited,
ALBERT WORKS, WIDNES.

THE WIGAN COAL & IRON CO., LIMTD.,
Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.
MIDLAND DISTRICT OFFICE: 22, TEMPLE ST., BIRMINGHAM—SOLE AGENT: A. C. SCRIVENER.
TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE NO. 200.
LONDON DISTRICT OFFICE: 6, STRAND, LONDON—C. PARKER & SON, SOLE AGENTS.
TELEGRAPHIC ADDRESS: "PARKER LONDON."

WENHAM LAMPS
With Recent Improvements.

PRICES
FROM
STILL THE BEST REGENERATIVE LAMP.
20/-
CHEAPEST! MOST ORNAMENTAL AND RELIABLE!

APPLY FOR NEW SEASON'S CATALOGUE.

THE WENHAM COMPANY, LTD. UPPER OGLE STREET, LONDON, W.

MEIKLEJOHN'S PATENT
Improved Slide-Valve Anti-Dip.
Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.
Is cheap and easily fixed to any form of main.
Will be found the most efficient appliance of the kind yet introduced.
Further particulars and price from
C. MEIKLEJOHN,
GAS-WORKS, RUGBY.
(Late N. MEIKLEJOHN, Longwood.)

FAMOUS LEESWOOD
"CURLEY CANNEL."
YIELD: 15,306 CUB. FT. PER TON OF 30·62-CANDLE POWER.
SMOOTH CANNEL.
YIELD: 12,321 CUB. FT. PER TON OF 21·321-CANDLE POWER.
PRICES AND PARTICULARS OF
MESSRS. S. CHANDLER & SONS,
LEESWOOD COAL AND CANNEL MINES,
PONTYBODKIN, nr. MOLD, NORTH WALES.

BOLDON GAS COALS.
Worked by THE HARTON COAL CO., LTD.,
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to
The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the
HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

NIDDRIE CANNEL
A FIRST-CLASS CANNEL COAL,
Yielding a large volume of rich Gas, and fully 60 per cent. of first-class Coke.
FOR ANALYSIS, PRICE, AND ALL OTHER PARTICULARS, APPLY TO
The Niddrie & Benhar Coal Co., Ltd.,
15, HANOVER STREET,
EDINBURGH.
Telegrams: "BENHAR, Edinburgh."

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,
for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cen'.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE,
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, LESSEE, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.
This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
11, BAY STREET, PORT GLASGOW.
Telegrams: "HUNTER PORT GLASGOW."
Established 1872.

THORNLEY GAS COALS
WORKED BY THE
WEARDALE IRON AND COAL COMPANY, Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.
The Analysis made by Messrs. J. and H. T. PATTINSON, Public Analyst for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a working Analysis made of these Coals by the Falmouth Gas Company:—
[COPY.]
FALMOUTH GAS COMPANY,
Offices: *Church Street, Falmouth,*
January 25th, 1893.
Messrs. the
WEARDALE IRON & COAL COMPANY, LTD.,
NEWCASTLE-ON-TYNE.
GENTLEMEN,
From the Cargo of **THORNLEY GAS COAL,** received early this month from you, I have Carbonized at these Works, during a period of thirteen consecutive days, 151$\frac{15}{20}$ tons of the Coal, mixed with 9$\frac{6}{20}$ tons of Cannel Shale (or about 6 per cent.)
The Make of Gas during the above period was 1,624,000 cubic feet.
The whole of the Gas was made from four beds of sixes (24 mouthpieces); each charge being of six hours' duration.
Gas made: 1,624,000 cubic feet.
Coal Carbonized: 151$\frac{15}{20}$ tons.
Cannel Shale: 9$\frac{6}{20}$ tons.
Make per ton of Coal and Cannel Carbonized: 10,082 cubic feet.
Coke per ton (of good quality): 13$\frac{1}{4}$ cwt.
The ILLUMINATING POWER averages from 11 daily tests, **16·54 CANDLES,** which was ascertained by burning the Gas at the rate of 5 cubic feet per hour in a certified Letheby Photometer, fitted with a Standard Argand, each Candle consuming 120 grains of Sperm per hour.
Yours faithfully,
J. WM. BUCKLEY,
Engineer and Manager.
For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.,
QUAYSIDE, NEWCASTLE-ON-TYNE.

G. WALLER & CO.'S NEW PATENT GAS EXHAUSTER
MADE WITH FOUR BLADES,
To pass 300,000 Cubic Feet per Hour, with or without Engine combined.
IN USE AND ON ORDER FOR OVER 100 WORKS,
AND EQUAL TO
5,340,000 CUBIC FEET PER HOUR.

SPECIAL ADVANTAGES:—
The Four-Blade Exhauster **PASSES 50 PER CENT. MORE PER REVOLUTION** than any One or Two Blade Exhauster.
It takes 27 per cent. less power than any Two-Blade Exhauster.
It gives a steadier Gauge than any other Exhauster.
One of our 150,000 feet per hour Patent Four-Blade Exhausters passes continuously **180,000** cubic feet per hour, driven by a **12-INCH STEAM CYLINDER.** No other Maker can give a similar result.
Model of Patent Exhauster sent for inspection.
Oldest Makers of Beale Exhausters for over 300 Works.
Patent Compensating Steam Governor, Special Tar and Liquor Pumps, Gas-Valves.
Washer-Scrubbers, with **WOOD CLUSTERS,** and Tar Extractor combined.

PHŒNIX ENGINEERING WORKS,
PARK STREET, SOUTHWARK, LONDON, S.E.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

Shipments Promptly and Carefully Executed.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY

Strongly recommended where EXCESSIVE HEATS have to be maintained.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

T. B. KITTEL, SHEFFIELD.

CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL

ENGLISH & SCOTCH CANNELS.

REAL SILKSTONE GAS COAL

ANALYSIS AND PRICES ON APPLICATION.

T. B. KITTEL, SHEFFIELD.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

CAST-IRON PIPES

FOR GAS AND WATER.

Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

VALVES

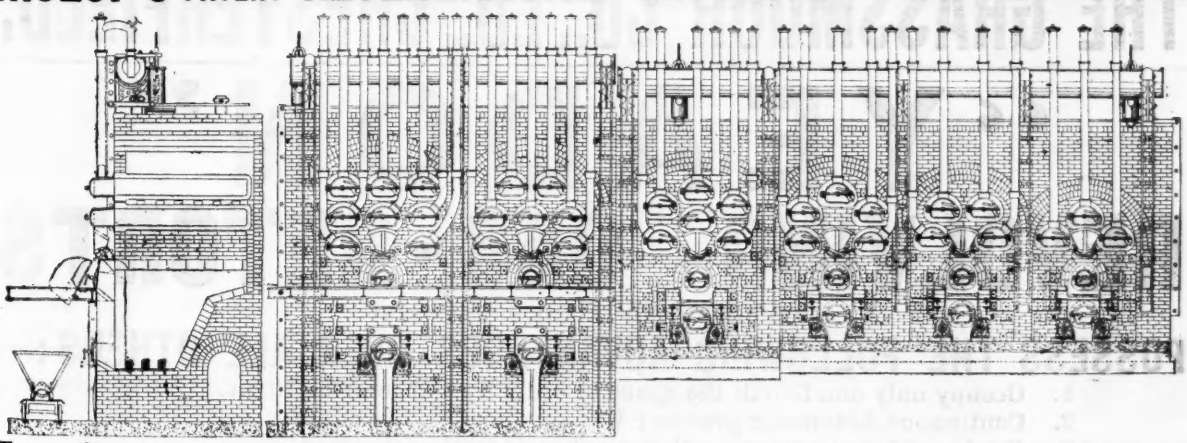
FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."

WM. MACLEOD & CO.,

56, ROBERTSON STREET, GLASGOW.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE ADAPTED TO THE REQUIREMENTS OF ALL GAS COMPANIES AND GAS CORPORATIONS, AND HAVE ALREADY BEEN EXTENSIVELY ADOPTED. THEY ARE ERECTED UPON BOTH THE WORKING-STAGE AND SHALLOW-CHAMBER SYSTEMS, AND EQUALLY SATISFACTORY RESULTS ARE GUARANTEED IN BOTH CASES.

THE SETTINGS HAVE ATTAINED TO A MEASURE OF SUCCESS AND POPULARITY QUITE UNEQUALLED BY THAT OF ANY OTHER WITHIN THE SAME SPACE OF TIME. THE WORKING RESULTS OBTAINED, AND THE GENERAL SATISFACTION GIVEN, ARE DECLARED IN EVERY CASE TO EXCEED, AND IN MOST CASES CONSIDERABLY EXCEED, THE PATENTEE'S GUARANTEE. THE CONSTRUCTION AND WORKING OF THE PATENT PRODUCER AND THE PATENT CHARGING APPARATUS FOR SAME ARE ABSOLUTELY UNIQUE AND UNRIVALLED, AND ARE THE DELIGHT OF EVERY STOKER; WHILE IN EVERY OTHER PARTICULAR THEY SECURE THE HIGHEST RESULTS ATTAINABLE BY ANY REGENERATIVE SYSTEM, AND AT A MINIMUM OF COST.

Drawings and Specifications are furnished for the complete erection of Ovens, with or without Retort and Bench Mountings, or complete erection undertaken if required, and carried out by specially Trained Workmen.

Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stewart Street, Shawlands Glasgow; J. E. FISHER, Stourbridge, and from R. F. HISLOP (son of Patentee), Gas-Works, Paisley.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine quâ non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED, AND AFFORDING THE HIGHEST SATISFACTION.

SPENT LIMES NO LONGER WASTE PRODUCTS

Under G. R. HISLOP'S PATENTS.

All Spent Limes are most effectually, economically, and continuously recovered at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it.

Descriptive Pamphlets and Terms from Agents as above.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,

SEAHAM HARBOUR, COUNTY OF DURHAM.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY FOR ENGINEERS.

STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.

London Office:

80, CANNON STREET, E.C.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

GAS COAL. BEST REAL OLD SILKSTONE GAS COAL,

Address THE STRAFFORD COLLIERIES COMPANY,

Near BARNSLEY, SOUTH YORKSHIRE.

HEATHCOTE GAS COAL.

RICH IN ILLUMINATING POWER AND YIELD OF GAS.

ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.

MAINTAINS A HIGH STANDARD IN RESIDUALS.

THE GRASSMOOR Co., Ld., CHESTERFIELD.

"YEADON" REVOLVING GAS-RETORTS

(YEADON AND ADGIE'S PATENTS)

POSSESS THE FOLLOWING ADVANTAGES OVER ALL OTHERS:—

1. Occupy only one-fourth the space of ordinary Carbonizing Plant.
2. Continuous Automatic process; Gas produced in 12½ minutes.
3. Produce 25 per cent. more Gas per Ton of Coal carbonized.
4. Richer Gas of 15 per cent. additional Illuminating Power.
5. Utilize the smallest size, therefore the lowest price, Coal.
6. Proportionate increase from large Coal when broken as for Stoking-Machines.
7. Enrichment of Gas by Cannel Coal, Oils, &c., rendered unnecessary.
8. No deposit of Carbon in Retorts, or choked Ascension-Pipes.
9. Fogs conquered by the production of Gaslight on five hours' notice.
10. 25 per cent. of Lime saved in the process of Purification.
11. Retorts can be used for Revivifying Spent Lime in 20 minutes.
12. Revivify Spent Oxide for the recovery of Sulphur Compounds.
13. Sunday Ordinary Labour and Nightwork reduced 75 per cent.
14. Overwork and Overtime abolished; also Casual and Foreign Labour.

For Articles on and descriptive of the above Apparatus, see *Journal of Gas Lighting* for Dec. 13, 1892; March 7, April 25, May 2, and May 16, 1893. Also, the *Gas World*, Jan. 21 and May 6, 1893.

FULL PARTICULARS AND ESTIMATES GIVEN BY

THE YEADON GAS-RETORT SYNDICATE, LIMITED,

4, ALBION PLACE, LEEDS;

Or their Sole Representatives: D. M. NELSON & SONS, 68, Bath Street, GLASGOW.

Wrought-Iron

And Fittings and Accessories.

LAMBERT BROS., WALSALL,

MANUFACTURERS OF

WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM,

BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c., AND OF WARNER'S PATENT MARKET GAS STAND-PIPE.

LONDON: LAMBETH BRASS & IRON CO., Short Street, LAMBETH.

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.

Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.

Telegrams: "ATLAS SHEFFIELD."

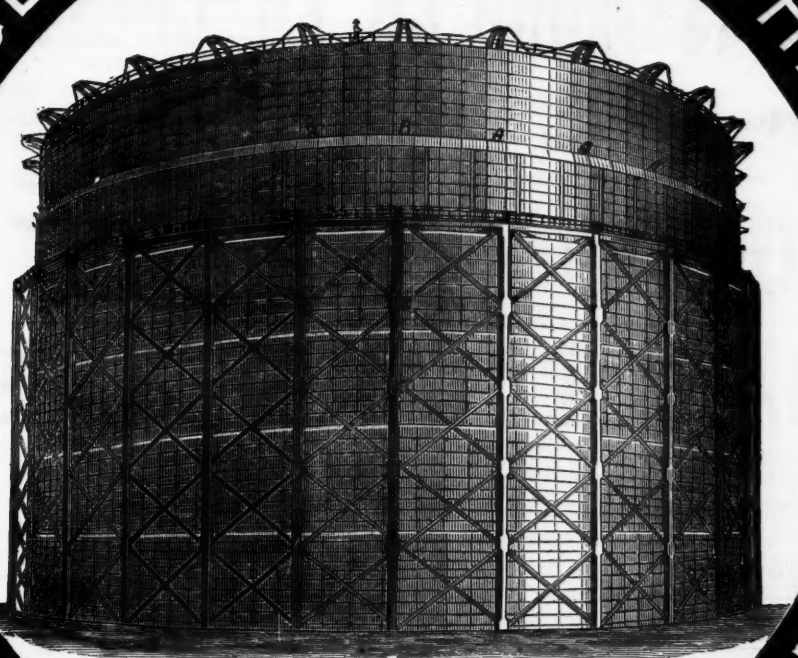
CLAYTON SON & Co. LTD

MAKERS OF

WORKS LEEDS

THE LARGEST GASHOLDER IN THE WORLD.

GASHOLDERS OUR SPECIALITY



CAPACITY 12 MILLION CUBIC FT.

ERECTED AT EAST GREENWICH FOR THE South Metropolitan Gas Company

IT HAS SIX LIFTS 30 FT DEEP EACH AND IS 300 FT DIAR

MAKERS OF GAS PLANT OF EVERY DESCRIPTION

ROOFS PURIFIERS &c. ALSO

ADDRESS LONDON 60, QUEEN VICTORIA ST.

TELEGRAPHIC "GAS, LEEDS."

GASHOLDERS OF ANY SIZE

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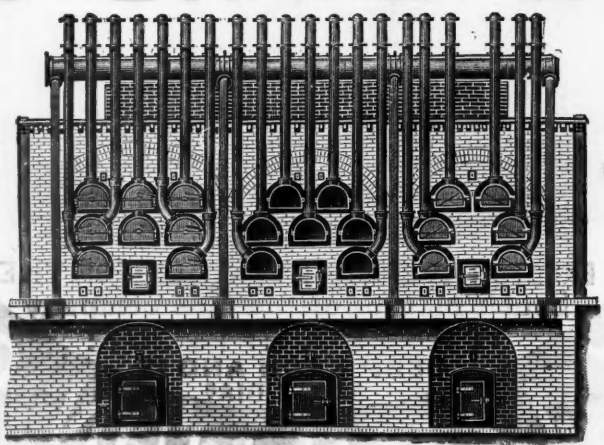

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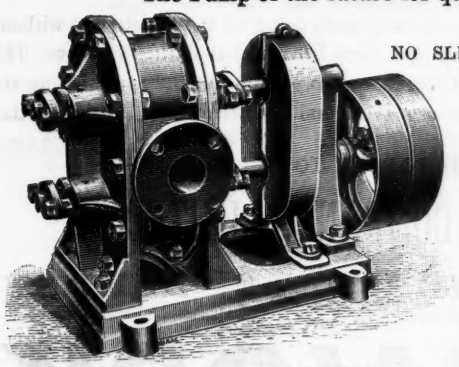

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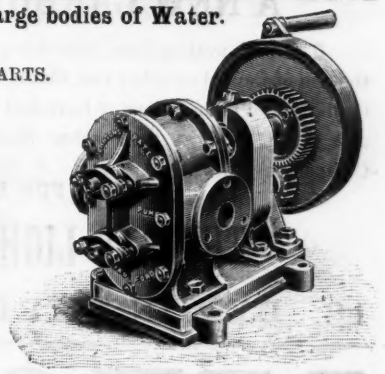

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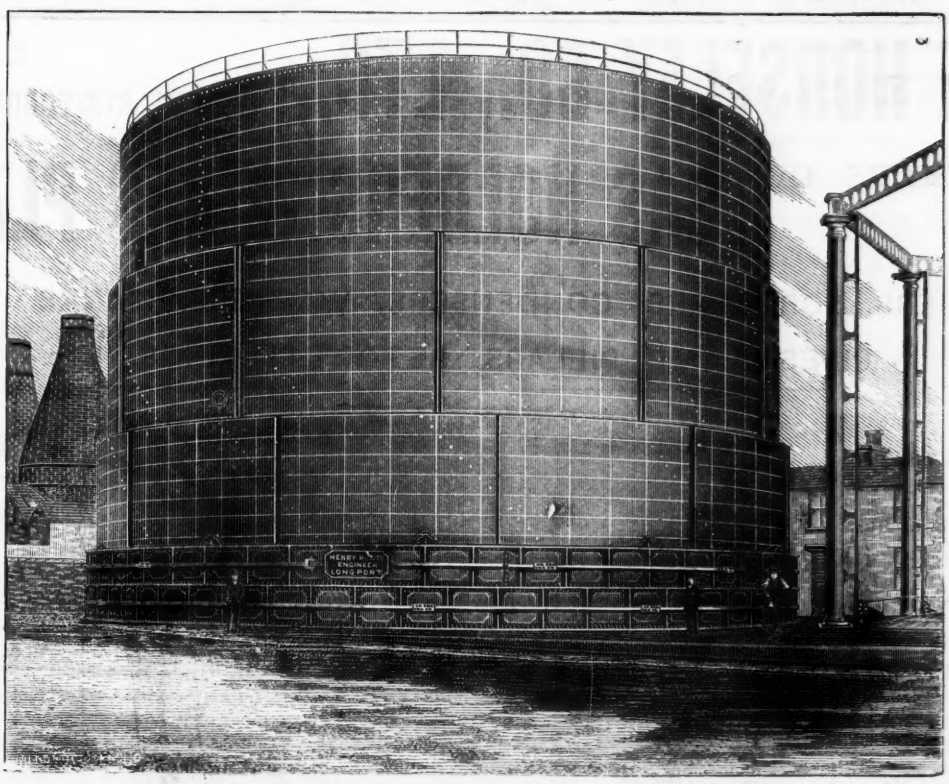

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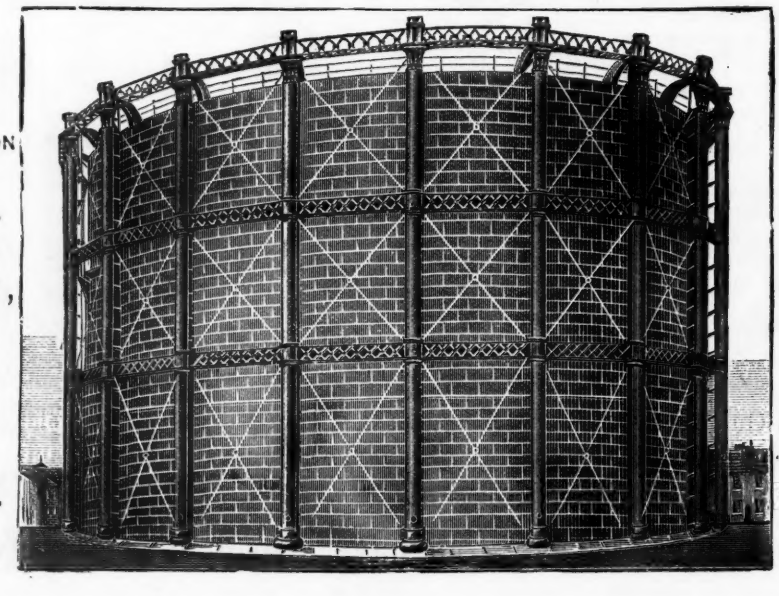

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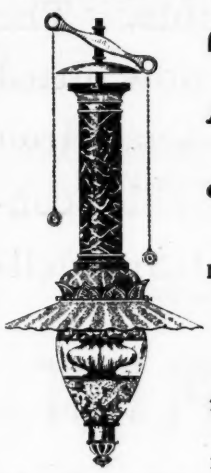

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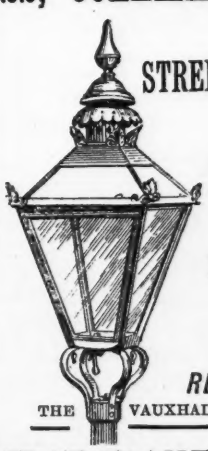

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[See also Advt., p. 1192.

London: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square): and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 27, 1893.

[Registered as a Newspaper.

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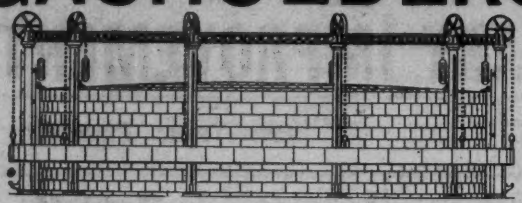

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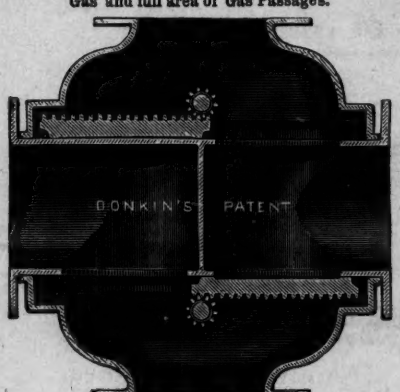

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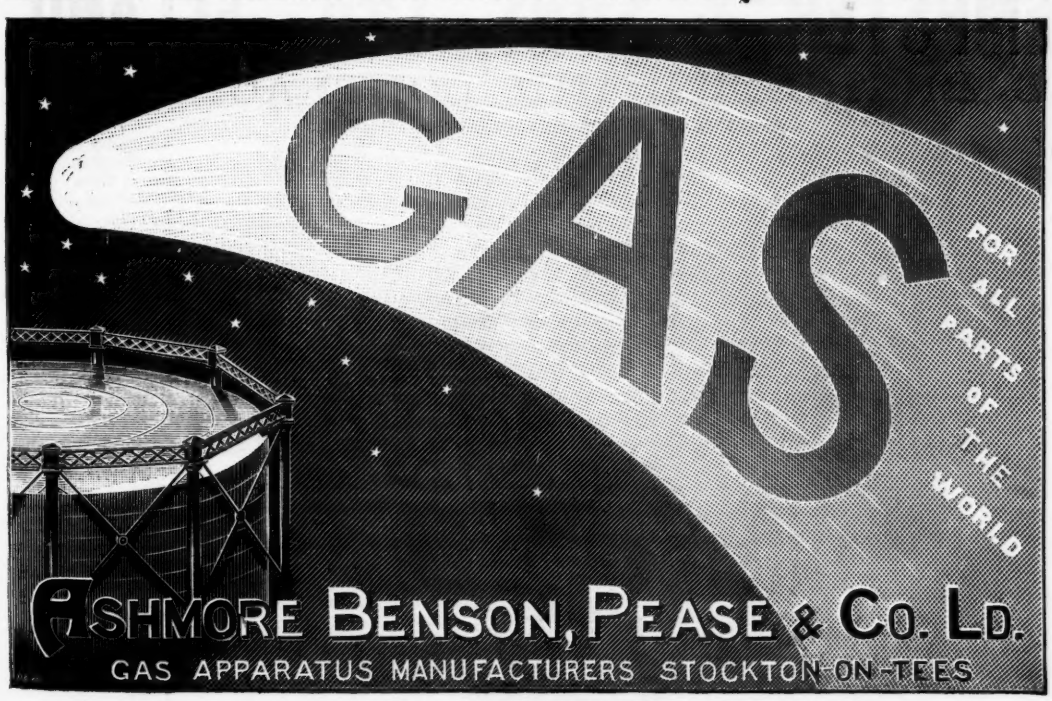

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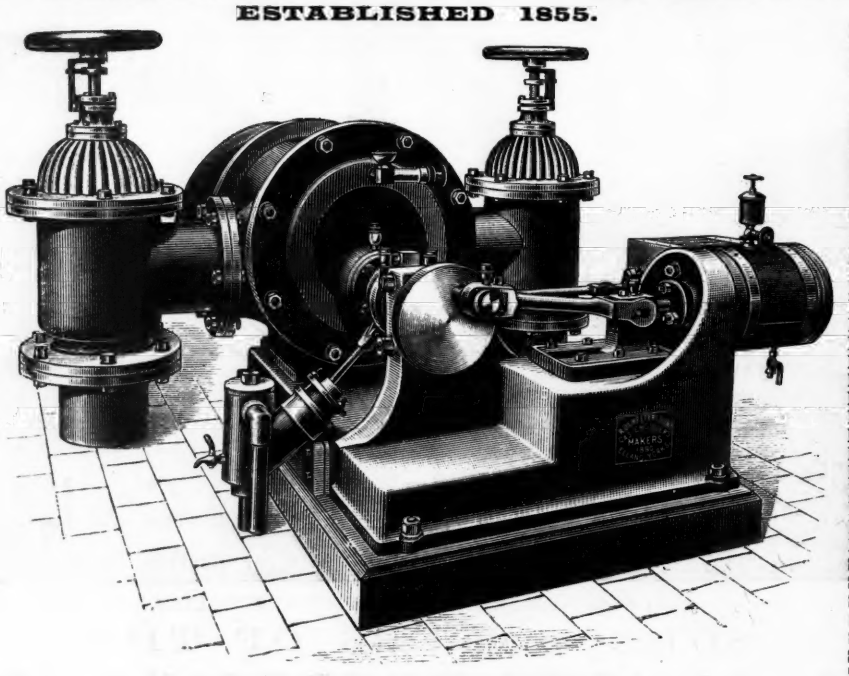

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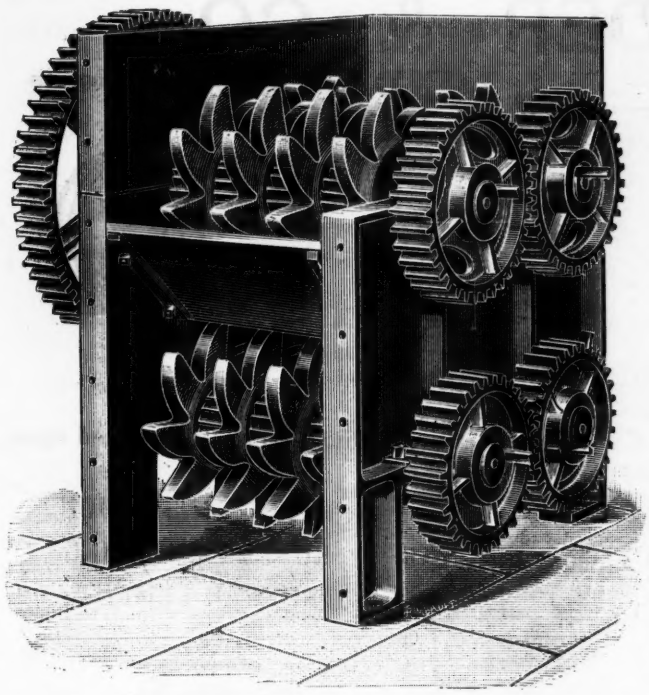

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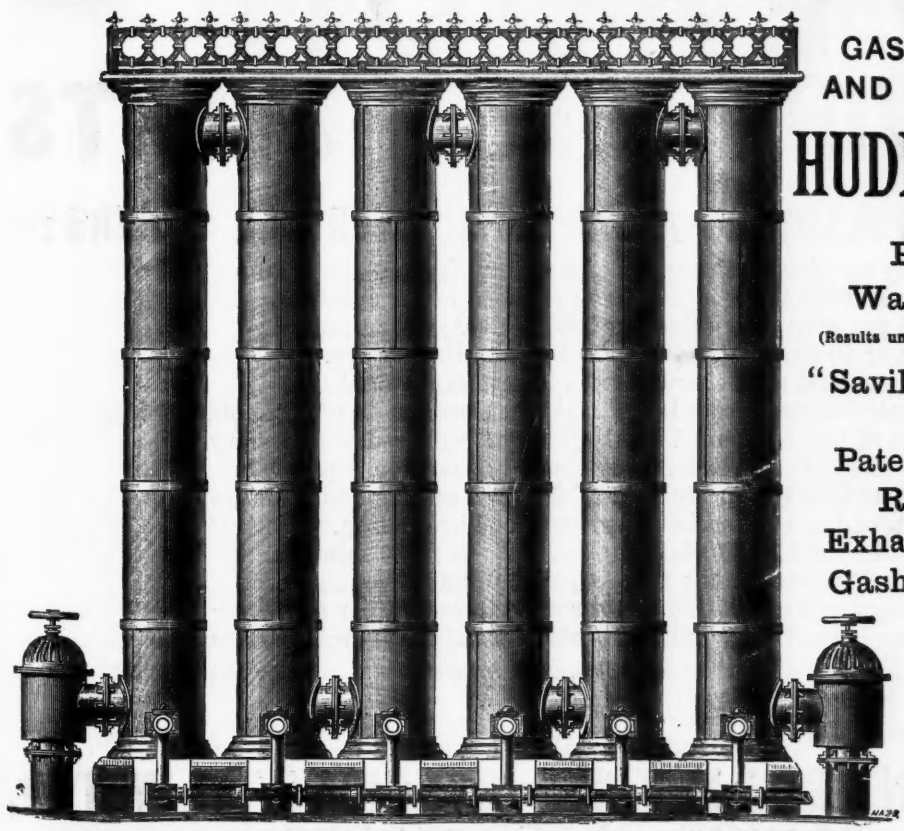

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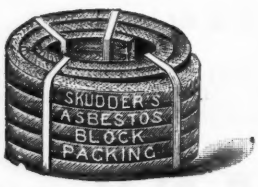

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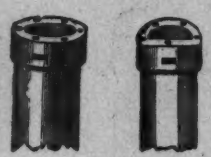

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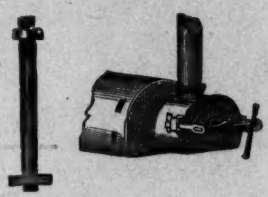

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London: Printed by Walter King (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 13, 1893.